THE
ELECTRICAL REVIEW.

VOL. LII. MARCH 20, 1903. No. 1,321.

"ELECTRICAL REVIEW."

Vol. LII.] CONTENTS: March 20, 1903. [No. 1,321.

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THE NEW WIRING RULES OF THE I.E.E.

IT has been within the knowledge of most people in the electrical profession and trades, that the Council of the Institution of Electrical Engineers has had in preparation a revised set of general rules; but to many who remember the first circular which was sent out some three years ago or more, it must have seemed as though the whole matter had been shelved, forgotten or lost sight of. That this was not the case could be confirmed by those who have, during the greater part of this period, been assisting the committee with their advice and criticisms; and now at length the new rules have been published, in a form which it is hoped will commend itself to everyone concerned, and gradually tend to their universal adoption. We propose to review them in detail in our next issue.

It is, we think, an open secret that the committee which was appointed to see this important work through, was set a most delicate task. At the time in question there were several factors tending towards the utmost confusion in the electrical wiring world. The 1897 General Rules had been issued during a period of transition, when the demand for electrical energy was rapidly forcing the supply authorities to increase the capacity of their mains by doubling the pressure of supply; and although these rules recognised the new state of things, they were issued at a time when every consulting engineer, station engineer, and fire office inspector was drawing up, or had drawn up, a set of rules based on his own limited experience of 250-volt supply. (We use the word "limited" advisedly, as the wider experience on which the present rules have been framed had not then been gained.) As a result, the personal element entered largely into the question, and authors of rules, which had given them considerable trouble to draw up were loth to sink their individualities by adopting quite another set of rules, in which they had had no hand. Consequently the 1897 Rules remained almost a dead letter; the Institution had no power to enforce them; and the cry of the wiring contractor went up: "How long?" This much persecuted person had to conform to the rules of at least two authorities who could make things unpleasant for him, to say nothing of the consulting engineer's own rules and those of the Institution, and more often than not some of the clauses were quite contradictory in effect; so when the Institution stepped in to endeavour to remedy this state of affairs, its Committee had to face the task of conciliating several rival opinions, and had to induce many lions and lambs to lie down together. It may be stated at this point that the experience gained during the interval which has elapsed has to a considerable extent tended to bring together divergent views; but, nevertheless, the evil is still great, as those who do wiring work all over the country can testify.

In order that its aim should the more readily be achieved, the Committee had on its *personnel* representatives of the various classes of expert already referred to, as it was thought that the influence of their opinions would tend to the framing of a foundation on which the actual rules could subsequently be built. This was actually the case, and as soon as a framework had been agreed on, then the really arduous

nature of the work became apparent. The Committee, no doubt recognising that their rules, framed by members who were only representatives and not delegates of the several interests concerned, could not be enforced, and were not likely to be adopted unless these interests were consulted, undertook the formidable task of sending out their suggestions broadcast; collecting and "boiling down" the replies and criticisms; amending their rules with the new matter obtained; and repeating this cycle during the greater part of the period which has passed; until at length the present rules have been evolved, which may be said to embody the views of the electrical world generally. Only those behind the curtain know of the hard work, the late meetings, and the innumerable worries which this work has entailed on the Committee; and if it has not finally succeeded in producing a perfect set of rules, this should only be because nothing in this world is perfect, but by earnest endeavour everything can be improved.

It is not suggested that the rules should be rigidly followed to the letter, but that they may be taken as a basis for all wiring work, in the interest of efficiency and of simplification; and more especially should the manufacturers and wiring contractors benefit, as the tendency will be towards the better standardising of fittings and accessories and the doing away with a multiplication of patterns. The Committee will be a permanent one, and we understand that it will always be ready and willing to consider all criticisms and suggestions, based on the experience of those who make them, so that the rules may from time to time be revised in accordance with any generally expressed opinions.

The Council and the Committee, to whom all thanks are due for their past efforts, should be supported in every way; and this we can best do by pulling all together, so as to assist them in their future endeavours.

PROPORTION IN DESIGN.

When an apparatus, or a collection of apparatus, known in such collective form as plant, works with smoothness and economy, this is not of necessity evidence of good engineering, nor even of good design, except in a very narrow sense of the word design.

Good engineering at least demands a suitable and not extravagant ratio of means to ends; but one of the worst developments of recent years has been the abnormal, wasteful, and unnecessary duplication of plant, and the employment of elaborate means for attaining a simple end.

The most familiar instance is the ring steam main, with its wasteful profusion of valves, contrived to shut off any engine from any boiler, any boiler from any other boiler, and to couple or uncouple everything to or from anything. The idea suited the valve makers, no doubt, but it was extravagant in first cost and wasteful in steam, which was condensed in huge volumes, and it raised up an abnormal trade in steam traps—devices which, however necessary in their place, are wasteful when used in excessive numbers.

Steam piping ought to be as short as reasonably practicable, and it should be made of the best material, well put together, and free from complication. Steam pipes do not become incrusted with scale; they are not exposed to fire, and therefore do not become overheated; they are small in diameter, and rarely as thin as $\frac{1}{4}$ in., so that the unit stress upon the material is insignificant. Yet they have been treated as though they were fragile!

In a certain power station there is a ring main in the boiler house, and another in the engine room. The engine room loop consists of two parallel pipes alongside of each other, so arranged that if one of them should go wrong by serious explosion, it would endanger the other one also. Thus any virtue that a ring main is, by courtesy, supposed to possess, is eliminated by this parallelism of its two loops. Further, the gallery by which the engineers gain access to the engines is directly above the two steam pipes, and the spindles of the stop-valves come up to this gallery, thus being out of the reach of the engineers in case of breakdown. It is easy to see that ring mains are an article of faith handed down by tradition from the past, which has not brought with it a parallel tradition of the reason for its existence. The ring main, in fact, is as useless as the "appendix" of which we hear so much.

In small stations that are not likely to increase, it may be sounder practice to employ three small boilers than two large ones. There would be less idle capital, as the total cost could usually be reduced, while with shell boilers the two large furnaces of a pair of Cornish boilers would give better results than the furnaces of a Lancashire boiler.

Superheaters are much employed nowadays. Often they are placed behind Lancashire boilers, in such a position that they cannot be cut out of the circuit of the hot gases by a simple damper. They must, therefore, be flooded when not in use, and it is possible that they suffer as much harm, as the result of flooding, as they would by over-heating.

They are put in so as to obstruct the inspection of a boiler, and themselves require to be lifted out of place for inspection. If they were arranged as they ought to be, they would be open to full inspection in place; they would not need to be flooded, and rarely to be lifted out of place.

One of the worst instances of extravagance in design is the provision of an electric crane to remove superheaters. If such a crane is justified it may be pretty confidently stated that the superheater is a commercial loss. A portable hand lifting gear of worm-wheel type should suffice.

There can be little doubt that if electric generating stations were designed with a rational appreciation of economy and sound judgment in respect of costly duplicate parts, the first cost and the maintenance charges would both be substantially reduced, and not only would there be no increased risk of breakdown, but probably a very much reduced risk upon a much smaller amount of plant.

Arrears of Electric Lighting Rent.

The case of the Gas Light and Coke Co., Ltd., *v.* the Cannon Brewery Co., Ltd., which was decided in the Court of Appeal on March 6th, raised certain questions of interest to those who supply electric light, inasmuch as the principles of law which govern the supply of gas and the right of the company to enforce payment of money due for gas supplied are the same as those which regulate the supply of electricity. It appeared that up to June 18th, 1901, one Lowles had been tenant of a house in the Harrow Road. On that day he sold his business to the defendants and gave up possession, leaving certain arrears of gas rent unpaid. His trade was then continued by the defendants. The question was whether, on the true construction of certain private Acts, the plaintiffs could sue for the arrears, or whether their only remedy was to cut off the supply of gas from the premises. Sec. 72 of the company's private Act provides that "in case any consumer leave the premises where gas was supplied to him without paying to the company the rent or meter rent due from him, the company shall not require from the next tenant of the premises payment of the arrears left so unpaid, unless the incoming tenant agreed with the defaulting consumer to pay the arrears, or unless the incoming tenant shall continue the trade or business of the outgoing tenant, and shall have paid to the owner, lessee, or mortgagee in possession, or to the outgoing tenant of such premises, a consideration for so doing; but the company shall notwithstanding any such arrears, in the absence of collusion between the outgoing and incoming tenant, supply gas to the incoming tenant as required by this Act on being

required by him to do so." It was contended on the part of the defendants that, inasmuch as the word "require" and not the word "recover" was used in the section, the gas company could not, in cases coming within the exception, actually sue for arrears. Their only remedy was to cut off the supply. The case of the Gas Light and Coke Co. *v.* Mead was quoted in support of this proposition. The Court of Appeal, however, have dissented from this decision, and have declared that the company have no power to refuse a supply owing to non-payment of arrears, unless there has been collusion between the consumer and his predecessor. In other words, refusal to supply cannot be used as a lever for the purpose of obtaining payment of arrears. They held, however, that the company were entitled to sue. The effect of this decision may be said to be that "An incoming tenant of premises who continues the trade or business of an outgoing tenant and who has paid a consideration to the outgoing tenant for so doing is personally liable and may be sued for arrears due from the outgoing tenant for gas supplied to the premises." So, it is conceived that in the case of electricity supplied, the company cannot switch off the current, but must bring suit against an incoming tenant for the sums due from his predecessor.

Secret Commissions.

Once again the House of Lords has been called upon to approve the second reading of a Bill for the suppression of secret commissions. In the course of his address to the House on March 10th, the Lord Chancellor drew attention to the chief clause of a Bill which provides that "if any agent corruptly and without the knowledge of his principal accepts or obtains, or agrees to accept or attempts to obtain, from any person, for himself or for any other person, any gift or consideration as an inducement or reward for doing or forbearing to do any act in relation to his principal's business, or for showing or forbearing to show favour or disfavour to any person in relation to his principal's business; or if any person corruptly gives or offers any gift or consideration to any agent as an inducement or reward . . . . he shall be guilty of a misdemeanour, and shall be liable on conviction on indictment to imprisonment." It is claimed for the proposed measure that its indirect effect will be as great as, if not greater than, its direct effect, and that the fact of the receipt or payment of a secret commission being made a criminal offence will tend to gradually exterminate the system. That the system is pernicious in the extreme no one will deny. In every branch of industry, not to say in every profession, it exists to a greater or less extent. It has been said that "every man has his price, and that all men can be bribed if only the proper method can be discovered." Without going to this length, it is impossible to shut our eyes to the fact that the evil is widespread, and that the growth of every new industry involves the development of some new system of secret commissions. Thus it is said that in the motor-car industry the system takes the form of a secret payment by the repairer to the *chauffeur* or other person responsible for the machine, of a percentage on the annual bill for repairs. Indeed, the system of paying commissions to servants and others is so notorious that to call it secret is a misnomer, and its total eradication, whether by making it a penal offence or by other means, would be desirable in the extreme. It is difficult, however, to see how the process of extermination can be carried out in actual practice. In the first place, how is the necessary evidence to be obtained? A commission is by no means confined to money or even to money's worth. It may assume a hundred different forms. Again, where a man in the position of a tradesman has been in the habit of giving secret commissions to servants for a number of years, he has probably not done so without a good return for his money. Will he be likely to turn round and inform against the servant at the risk of becoming incriminated himself, and with the certainty of losing the custom which the servant in question has hitherto influenced?

In our view the passing of an Act of this kind could at best have but a moral effect. We doubt very much whether it will ever reach the more pernicious forms of secret commissions which permeate our commercial system.

THE PRESENT POSITION OF THE ALUMINIUM INDUSTRY.

By JOHN B. C. KERSHAW, F.I.C.

1.—Production and Finance.

The recent crisis in the financial affairs of the British Aluminium Co., and the fact that the production of aluminium by the Heroult process is now an open manufacture in this country, the British patent having expired in 1901, renders a survey of the position of the aluminium industry in Europe and America at the present moment of some interest. The number of works producing the metal either by the Hall or the Heroult process is now nine, situated as follows:—America, 3; United Kingdom, 1; France, 2; Germany, 1; Switzerland, 1; Austria, 1. The power available for the production of aluminium in these nine works is between 36,000 and 40,000 H.P., all derived from water.

The output of aluminium, based upon the assumption that the whole of this power is employed in the manufacture, would be about 11,500 tons per annum. It is known, however, that none of the European works are at present using all their available power for aluminium production, and a reliable estimate of the output of the metal in Europe and America in the years 1901 and 1902 has given the following figures:—

	1901.	1902.
European works (6) ...	4,000 tons.	3,800 tons.
American works (3) ...	3,240 „	4,200 „
Totals	7,240 tons.	8,000 tons.

The diminished production of the European works in 1902 is to be ascribed to a practically stationary demand for aluminium in the arts and industries, and to the desire on the part of producers to reduce the stocks of the metal gradually accumulated in previous years.

It may be explained that the European producers are unwilling to give official figures for their output in recent years, and the totals given above are based on study of the statistics published in previous years, and upon independent inquiries in many directions.

Two new works for the production of aluminium are planned, and one is now in course of erection. The latter is at Massena, U.S.A., where the Pittsburg Reduction Co. have bought land. It is intended to utilise at this works the power already developed by the St. Lawrence Power Co.

Readers of the Electrical Review are acquainted with the scheme of this company, which has developed 50,000 H.P. at Massena at a cost of over £2,000,000. Owing to bad commercial management, the lands and works of the Power Co. have passed into the hands of the debenture-holders and their representatives, but a reorganisation of the financial affairs of the company is now occurring, and the Pittsburg Reduction Co. hope to have their new extraction works in operation by April of this year. The plant now being installed consists of 4 × 300 H.P. machines, generating current at 500 volts, and as the demand for aluminium in America increases, the works at Massena will be extended.

The second new works for aluminium production is to be erected at Zudovic, in Spain, where water-power is available; but this project is still in the initial stage of its development. A Franco-Spanish syndicate of capitalists is promoting the undertaking.

As regards the price of aluminium, little change has occurred in recent years, and until some cheaper method of preparing the raw materials for the electrolytic bath has been discovered, it is unlikely that any marked reduction in the cost of manufacture, or of the selling price, will occur.

The November, 1902, prices of the Pittsburg Reduction Co. were as follows:—

No. 1 metal guaranteed over 99 per cent. ...	16½d. to 18½d. per lb.
No. 2 „ „ „ 90 „ ...	15½d. to 17d. „
Nickel-aluminium alloy (less than 10 per cent. Ni.)	16½d. to 19½d. „
Powdered aluminium	45d. to 50d. „
Aluminium castings	22½d. „

All the above prices were subject to discounts, ranging between 10 per cent. and 15 per cent., and an import duty of 4d. per lb. on ingot metal, and 6½d. per lb. on sheet aluminium, protects the Pittsburg Reduction Co. from European competition. The American prices for aluminium rod and wire varied from 19d. to 26d. per lb., according to the gauge, and a rebate of 1½d. to 2d. was allowed off the list prices, according to the total size and value of the order.

The latest price list of the British Aluminium Co. gives the following figures :—

Ingot metal (guaranteed over 99 % Al.) ...	16½d. per lb. less	7½ %
Do. (98-99 %)	15d.	„	„ 7½ %
Do. (No. 4 alloy)	15d.	„	„ 2½ %
Do. (No. 6 alloy)	13¾d.	„	„ 2½ %
Wolframinium alloy	17½d.	„	„ 2½ %
Aluminium wire, Nos. 1-14 I. S.W.G. ...	23½d.	„	„ 2½ %

During 1902, the European manufacturers of aluminium have had one or two meetings for the purpose of regulating the production and price of the metal. No official report of the proceedings at these meetings has been published. The chairman of the British Aluminium Co. is, however, dissatisfied with the share of the European output and trade allotted to the Foyers Works, and an attempt is to be made to obtain some alteration in this respect. At the meeting of the shareholders of the British Aluminium Co. held in November, 1902, Mr. R. Wallace, K.C., the former chairman, stated that in his opinion the financial difficulties of the company had been partly due to the maintenance of too high a price for their products. This policy had not only retarded sales, but had led to the invasion of the British market by outside manufacturers.

As regards finance and dividends, the following are the latest figures available for publication :—

The Pittsburg Reduction Co.—Reduction works at Niagara Falls (2), and at Shawinigan Falls (1); capital, $1,600,000, divided into $1,000,000 of ordinary stock paying 10 per cent., and $600,000 of preference stock paying 6 per cent. The surplus profits of this company are reported to be sunk in new developments. The company is registered under American laws, and no official figures have been published. The low capitalisation, as compared with the European companies, is chiefly due to the fact that at Niagara Falls and Shawinigan Falls the water-power has been developed by independent companies.

The Aluminium Industrie Aktien-Gesellschaft.—Reduction works at Neuhausen, Rheinfelden and Lend-Gastein. Capital, £641,000 ; gross profits for 1901, £81,400 ; dividend for 1900, 12½ per cent.; for 1901, 13 per cent.

Société Electro-Métallurgique Française.—Reduction works at Froges and La Praz. Capital, £600,000. No details as to profits and dividends in 1900 and 1901 are available for publication.

The British Aluminium Co.—Reduction works at Foyers, N.B. Capital authorised, £700,000 ; issued, £640,000. This company has never paid any dividend on its ordinary shares, but has maintained payments on its preference stock and debenture stock up to recent date. In 1901 the preference dividend was passed, and in 1902 default was made with the debenture interest payment due on November 1st.

The financial affairs of this company are now in course of re-organisation. The causes that have led to this step were fully dealt with in the last directors' report, which appeared in this paper on November 14th and 28th, 1902.

As regards the remaining producing company, the *Compagnie des Produits Chimiques d'Alais*, with works at St. Michel, in France, no figures relative to capitalisation or profits are available.

No details of any value relating to the reduction process as actually carried out in the various works have been published in recent years ; but Haber and Geipert have carried out laboratory researches on the electrolytic reduction of Al_2O_3, and have published their results in the *Zeits. f. Elektrochemie* of January 2nd and 9th, 1902. These investigators have found that it is possible to obtain aluminium of a high degree of purity by the electrolytic method, if proper attention be given to the purity of the raw materials used in the process, namely, the electrode carbons, the cryolite, and the alumina.

Haber and Geipert, in their experiments, used a current density of 2,800 amperes per sq. foot, and an E.M.F. of 7—10 volts. The electrolytic bath contained aluminium fluoride, sodium fluoride, and alumina, in equal proportions. The metal obtained contained from ·034 per cent. to ·30 per cent. Si., and only ·05 per cent. C., and the tensile strength averaged 21,000 lbs. per square inch.

The interest of this research lies chiefly in the full details given of the conduct of the electrolytic reduction of alumina ; in the opinion of the investigators, the recent improvements in the process as carried out in the various works engaged in the industry, are due not to secret modifications of the process, but to greater care in the selection of the raw materials for the baths.

The patents covering the electrolytic production of aluminium have already expired in this country, and have only a short period to run in Germany and the United States. If the industry were very remunerative and flourishing, it is possible that the publication of Haber and Geipert's paper might have important results in bringing fresh competitors into the field.

In view of the present financial position of one of the European companies, and the somewhat disappointing growth in the European demand for the metal, it is, however, unlikely that any considerable increase in the number of aluminium works will occur at present. The existing works in Europe can more than meet the present demand for the metal ; and the consumption of aluminium in the arts and industries will only show rapid increase, when further reductions in its cost of manufacture have been made. Recent patents show that those engaged in the industry are directing their inventive ability to this question, and possibly, at no distant date, the problem of supplying a cheaper raw material than refined alumina for use in the extraction works will have been solved.

SAFETY DEVICES FOR TRAMWAY TROLLEY WIRES.

By DONALD SMEATON MUNRO, A.I.E.E.

(*Continued from page* 429.)

In figs. 5 to 10 they are wound or balanced so as to oppose and neutralise each other when all is in good order, but so that one or the other attracts their common or inter-connected armature when the balance of the pull of the coils is sufficiently upset by any accident to the guard or trolley wires. These coils are preferably made with many turns, and of (or in circuit with) high resistance so that small currents only need flow to actuate the apparatus and keep the guard wire at a very low potential difference from earth. When an accident occurs to the overhead construction, there are over 50 different electrical conditions in which the trolley, the guard and a falling telephone wire may establish themselves in respect of mutual and earth contacts between their several ends, and a good device should do the right thing in all, cutting off when the public is endangered, and remaining on when otherwise. The resistances and pull of electro-magnets also, must be so adjusted that the balance is not effectively upset by the ordinary fluctuations of demand from the trolley wire.

Most of these devices could be made self-restoring when clear, but this is dangerous. For a fragment of live wire may continue to hang down, say from T, and clear of earth. A "line-clear" indicator at the station could not show this.

But we need concern ourselves here only with five simple cases stated in a broad and general way :—

(1) When a fallen telephone or other odd wire rests on the guard wire only ; (2) when it rests (earthed) on the trolley wire only (for a springy wire sometimes, if rarely, evades the guard) ; (3) when it rests on both trolley and guard wires ; (4) when guard (or span) wire breaks and rests on trolley wire ; and (5) when trolley wire breaks. In what follows, these several conditions will, for the sake of brevity, be referred to by their numbers.

In fig. 3, which, as has been said, is a suggested development of Mr. Quin's device, the coil B supplied from feeder,

is not connected to the pilot wire P, but is put to earth only when complete failure of current in P destroys the pull of an extra coil C. This happens in case (5), to provide against which this particular appliance is chiefly designed. When the earth-connected armature C′ of C falls, it makes contact with the free terminal of coil B (or pushes an earthed contact against such terminal) putting B to earth. B then pulls its armature and releases S. When the current is shut off, as at night, from the feeder, C′ drops; but, of course, B, getting no supply from feeder, cannot then act. To prevent B acting first when pressure is restored to the feeder at the generating station, the core of C is well laminated, and its armature C′ may be also held clear of the contact by a weak spring or balance weight readily overcome for a moment by the oscillation of C′ due to the momentum of its fall. Coil A (which in this particular case need not be wound to oppose or balance coil B) acts when T is overloaded, or earthed, as by cases (2), (3) or (4). In case (1) the switch S remains on, as it ought to do, the guard wire being normally earthed, or neutral if preferred.

In fig. 4 the switch happens to be represented as if in the generating station, or in a sub-distributing chamber or other convenient position, and not as if in a street pillar near a feeding point, as are the others. The feeder is therefore continued beyond the switch to any desired feeding point or points, while the connection to the guard wire is made at the nearest available point of section. In this arrangement the guard wire is run on insulators and earthed only through the coil B and any resistance which may be in circuit with it.

The working load of the trolley wire current, passing through the coil A, is not enough to pull the armature, but an overload will do so, as in the ordinary overload switch. But if T be connected, even for an instant, to G, as by cases (3) and (4), a strong current flows in B, which pulls the armature and opens S. Case (1) is harmless, and does nothing. If a telephone wire falls on the trolley only, somehow entirely escaping G, then, but only if such wire be well earthed, it will cause A to pull. Similarly, if T break, case (3), and make earth at feeder side of break, A will pull. Fig. 2 contact pulls may be added for further security against injury by fracture of T in all cases where the device does not otherwise fully provide for this accident.

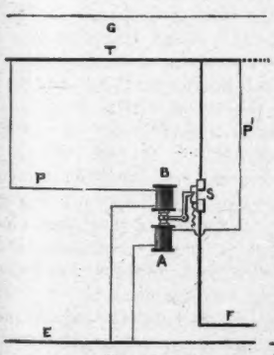


Fig. 5.

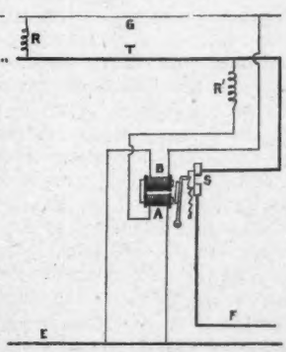


Fig. 6.

Fig. 5 is a further development of fig. 3. No coil carrying main feeder current is needed, but, of course, such a coil could be added to most of these devices with its own releasing mechanism to act on S, which would serve as a common overload switch. Fig. 5 differs from fig. 3, chiefly, however, in the introduction of coils wound or placed so as to oppose each other and to approximately balance when all is in order. All the following arrangements illustrated have this feature. The coils A and B have a common movable core (or balanced armature), to which the detent arm of S is attached, say, by a pivot pin. The guard wire, if present, is preferably directly earthed. Instead of only one pilot wire from far end of T, there is also another pilot wire from near end, or, preferably, one from each extreme end of a trolley wire fed in the middle. (In the latter case a simple and obvious modification of the releasing mechanism is needed.) Of course in all such instances it is not essential that the trolley sections radiating from feeding point be in a single continuous line; they may run parallel or otherwise. Each of these pilot wires P and P′ is passed through a high resistance coil B or A respectively to earth. Things are adjusted so that fluctuations of pressure in T due to variation of traction current do not suffice to set off S. But a fracture of either side of T, case (5), would permit the other coil to exert its full force unopposed and actuate S. Also the earthing of either side of T, *viâ* G or otherwise (or its overload unless where close to feeding point) would cause so great a drop in that side of T that the coil of the other side, less affected, would be able to pull the common armature and open S; but this figure is chiefly intended to provide disconnection where T breaks. Station fluctuations in feeder pressure, acting on both coils alike, have no influence upon them. The gravity of the common armature core is balanced by a spring when it is placed vertically as drawn. It can be combined with fig. 1, having a common S to make a complete system.

In fig. 6 and figures following, the guard wire is used instead of a pilot wire. G, run on insulators, is earthed at near end, but only through coil B, and is connected at far end to T, through a resistance R. This resistance R is made high enough to keep G at a safe potential, and to reduce to smallest limits the current constantly flowing from T, through R and G, to earth. The only practical limit to R is that it must be distinctly more than the insulation resistance of line in wet or snowy weather. R may be a group of under-incandesced glow lamps in series, or the energy spent in it may be otherwise utilised. (An electrostatic relay may be used to close circuit of such switch coils, but such an arrangement, having no constant small current in R, does not reduce potential of G to a safe limit.) The near end of trolley wire is joined through a similar resistance R′ and coil A to earth. The action is otherwise as in fig. 5, but it provides for cases (1) to (5). Coils A and B are wound to oppose each other.

(To be concluded.)

TRADES UNIONS AND THE LAW.

To deal adequately with the cases which have recently been decided in relation to trades unions, one would require to write a legal text-book on the subject. Since the Taff Vale Railway case, which was decided in July, 1901, disputes between employers and trades unions have been constantly before the courts, and, speaking generally, they have been decided against the unions.

Employers have sued for, and have been awarded, damages resulting from strikes, and they have obtained injunctions to restrain picketing; while workmen have successfully sued trades unions to recover damages resulting from the conduct of union officials who have persuaded employers not to give them work.

Last, but not least, in the Denaby Main case, which was decided in the Court of Appeal on January 27th, an injunction was granted at the instance of a single member of a trade union to restrain the committee from granting strike pay to men who were taking part in a strike which had been begun in contravention of the rules of the union. It will at once be seen that this case goes further towards hampering the power of trade combinations than any which preceded it. It really amounted to an interpretation of the rules by the Court. Further, it is declaratory of the principle that when the funds are being devoted to an illegal purpose, the aid of the High Court may be invoked to restrain such misapplication.

Seeing that the present law, although somewhat confusing to the non-legal mind, is distinctly unfavourable to the trenchant methods which have so often been resorted to by labour agitators, it is not surprising that steps are about to be taken with a view to obtaining some modification of the law of conspiracy which has such a direct bearing upon the legal position of the unions. Shortly after the jury had found a verdict in the Taff Vale case against the Amalgamated Society of Railway Servants, a Bill was drafted by the legal advisers to the Trade Union Congress, which is intended to be presented to Parliament in the coming session. Perhaps

the most conspicuous feature of this Bill is a clause where it is suggested that the law should be modified so as to make it legal for a number of persons to agree together to do anything which one person acting alone has a legal right to do.

The significance of this proposal becomes apparent to anyone who considers the case of Quinn *v.* Leathem. In that case it was proved that an officer of a trade union, in combination with the members, induced a servant to break his contract with his employer; that he induced a customer of the employer, by threats of calling out the customer's men, to withdraw his custom; and that he also induced an employer's servant to leave his service. In these circumstances it was decided that there had been an actionable conspiracy for which the officer of the union was held liable in damages. Lord Lindley, in the course of his judgment, observed:—"It is said that conduct which is not actionable on the part of one person cannot be actionable if it is that of several acting in concert. This may be so where many do no more than one is supposed to do, but numbers may annoy and coerce where one may not. Annoyance and coercion by many may be so intolerable as to become actionable, and produce a result which one alone could not produce." The object of the proposed Bill is to overrule this *dictum;* but we doubt if any Parliament could ever be brought to deny its intrinsic justice. Although Lord Lindley gave no concrete instance of his meaning, it is not difficult to find one. As the law now stands it is not illegal for one man to persuade another to do that which he has a legal right to do. It would not be illegal for one man to persuade another to give notice to terminate his contract of employment; it is even doubtful whether it is illegal for one man, who professes to be acting partly in his own interest, to persuade another to terminate his contract of employment without notice. But when a powerful trade union, having thousands of members upon its books and a large accumulated fund, uses persuasion, the whole aspect of the case is changed. In such circumstances persuasion becomes coercion, which no employer could hope to resist.

Among the other suggestions contained in the proposed Bill is to be found a proposed modification of the law relating to picketing, but we doubt whether the conduct of pickets in the past is likely to tempt the House of Commons to extend their powers any further.

While we do not appreciate the claim of the unions to have the law altered, it must be admitted that there is urgent need for a more lucid statement of the law than that which is to be found upon the Statute Book. The experience of the last few years has shown that the Trade Union Acts from 1871 to 1876 have become obsolete, and that a new Act might be drafted to embody the principles laid down in recent cases.

Mr. Haldane, K.C., at a meeting of workmen which was held at Mansfield Hall, Canning Town, on January 20th, tendered very sound advice to the trades unions. He said that they should postpone their agitation for a change in the law until such time as it is made quite clear what the law really is. In the course of his remarks he said:—"What I should like to see would be the appointment of a Royal Commission. It should consist of three experts, say, two of the most eminent judges in the land, and some layman, who have a wide experience of trades unions, and who take a wide fair view of them. This Commission should be asked to decide whether the present decisions can stand together, and if they cannot stand together, I should like the Commission to say what the principles of law really are. The Commissioners might also deal with the question of picketing, providing always, in any suggestion made by them, that the liberty of the subject should never be interfered with by the legislation of a nuisance."

With the law thus stated, it might be possible to consider whether the trades unions are entitled to any relief.

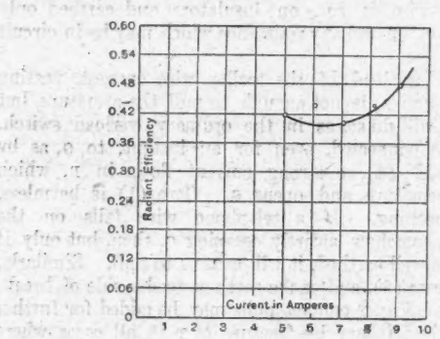
Municipal Trading.—The Hon. Robert P. Porter read a paper on Friday last on "The Conflict over Municipal Trading," at the London School of Economics and Political Science, Clare Market. A short discussion followed.

EFFICIENCY OF THE MERCURY ARC.

In view of the considerable amount of interest that has been excited in the mercury lamp by the demonstrations of the Cooper-Hewitt invention, a paper by Mr. W. C. Geer in the *Journal of the Franklin Institute* on the efficiency of the mercury arc deserves the attention of our readers.

The mercury arc appears to have been used for lighting purposes by Way as far back as 1860. Way had a "mercurial electric light" on the mast of a yacht off the Isle of Wight, where its brilliant radiation was observed over a distance of many miles. Way's discovery set many inventors to work on this subject, and as a result many patents for mercury vapour lamps have been taken out in this and other countries. None of these lamps have proved a commercial success for artificial lighting, though they have rendered valuable service to pure science as a source of mono-chromatic light of high intensity.

The device usually employed in the production of the arc is some form of the tube or "lamp" described by Arons in 1892* and in 1896. This consists of an inverted U-tube having the two legs filled with mercury, and platinum wire terminals fused through the ends. The space above the mercury is exhausted as far as possible.



Mr. Geer so arranged his experimental apparatus that he was able to eliminate the radiation from the hot glass of the tube, which was pretty considerable when large currents were used.

The relation between the current passing through the tube, and the efficiency, is shown by the accompanying diagram. It will be seen that, on the whole, the efficiency increases as the current increases. From this it follows that the intensity of the visible part of the spectrum increases more rapidly than that of the invisible part. This does not agree with the results obtained by Angstrom from experiments on vacuum tubes. He found† that at constant pressure the radiation was proportional to the current, and the distribution of energy in the spectrum was independent of the current. But, of course, in the Arons lamp the pressures may not remain constant for all currents.

The following table gives the radiant efficiencies of a few of the more common sources of light:—

Source.	Observer.	Efficiency.
Illuminating gas, argand burner	Rogers.	0·0161
Incandescent electric lamp ...	Merritt.	0·060
Arc light	Tyndall.	0·104
Acetylene...	Stewart & Hoxie	0·105
Geissler tube	Staub.	0·320
Mercury arc	Geer.	0·409 to 0·479

It must be remembered that these results indicate the efficiency only of that part of the radiation from the mercury arc which was passed through the glass tube within which the arc was formed. As it is, the mercury arc has the highest efficiency of all known sources of light.

* *Wied. Ann.* 47, 767, 1892; 58, 73, 1896.

† *Wied. Ann.* 48, 509, 1893.

LEGAL.

Medhurst v. Peterson.

In the King's Bench Division of the High Court of Justice on Thursday last week, before Mr. Justice Grantham and a special jury, the case of Medhurst *v.* Peterson came on for hearing. It was an action brought by Mr. Francis Hastings Medhurst, electrical engineer, Victoria Street, Westminster, and Manchester, to recover damages from Mr. Edward W. Peterson, solicitor, Lincoln's Inn Fields, for libel upon the plaintiff in his capacity as consulting engineer, and contained in a letter to the vice-chairman of the Frome Urban District Council. Defendant did not admit publication, denied that the words bore the meaning alleged, and pleaded that in their ordinary meaning they were true in substance and in fact, and were *bonâ fide* criticism and comment upon existing facts. Mr. Duke, K.C., and Mr. Sharpe appeared for the plaintiff, and the defendant was represented by Lord Coleridge, K.C., and Mr. Cancellar.

Mr. Duke, in opening the case, said the plaintiff's principal business had been that of consulting engineer in the development of electrical schemes by local authorities. One of the parties who consulted him was the Frome Urban District Council. In 1900 the District Council consulted the plaintiff about obtaining powers for electrical supply. The defendant and some friends heard of this intention, and informed the District Council that they proposed to ask for Parliamentary sanction to establish an electrical supply company in Somersetshire, and invited the Frome Council to hold their hands for the present. The matter was discussed between the Council, some of the ratepayers, and the plaintiff, and the plaintiff told the meeting that, in his view, it would be better for the Council to set up their own station and plant, but he gave them an alternative plan by which the Council might get one of the electrical companies to carry out the undertaking, and he mentioned the Edmundson's Electricity Corporation, the General Electric Co., and the Electrical Construction Co., as companies who might do it. Plaintiff also presented the Council with a form of contract which Edmundson's to his knowledge had been carrying out with one or other of the local bodies to whom he was consulting engineer. Mr. Ames, clerk to the Frome District Council, wrote to the defendant asking for information as to what the proposed company would do. That was on July 11th, but it was not until August 18th that the defendant replied, and in the meantime the District Council had decided to advertise for tenders. A meeting of the Council was to be held on September 1st, and two days before that the defendant wrote to the vice-chairman of the Council a letter, in which he said:—"My attention has been called to the fact that Mr. Medhurst, of 13, Victoria Street, Westminster, has been appointed consulting engineer to your Council. I enclose a prospectus of the Urban Electrical Supply Co., which is an offshoot of Edmundson's Corporation, and is controlled by that board, as you will see if you read the prospectus. Mr. Medhurst is the consulting engineer of the Urban Electrical Supply Co., and I suggest to you that your engineer should hardly be the consulting engineer of Edmundson's business under the circumstances, but should be acting in the matter purely in the interests of your Council and their prospective consumers. If the Council will wait a little longer, the above syndicate will be in a position to save them the expense of a generating station." The plaintiff was the consulting engineer to the Urban Electrical Supply Co., and had had the supervision of Edmundson's work for that company. By saying, therefore, that the plaintiff was the consulting engineer of Edmundson's business, the defendant was saying that, if continued in his appointment as consulting engineer to the Frome Council, he would not look after the consumers' interests, but after Edmundson's interests. The defendant's letter was shown by the vice-chairman (Mr. Trotman) to the members of the Council, and sent to the local press. One paper published it, but struck out the defamatory part; and the editors of the other papers sent proofs of it to the plaintiff for his answer. As the contents of the letter were calculated to damage the plaintiff in his profession, he had felt bound to take the present proceedings.

Evidence bearing out the above statement having been given,

Lord Coleridge, for the defence, said that not only did the defendant make no attack upon the personal honour of Mr. Medhurst, but he thought the jury would say that no reflection on Mr. Medhurst's honour was made or intended to be made. All that was suggested was that a man could not act in a dual capacity, and to say that was not to make a reflection upon his honour, but simply to point out the truth of an axiom which was as old as the Scriptures, that no man could serve two masters. The fact was that there was to be a discussion in the Frome Council as to which mode of electrical supply would be in the interests of the ratepayers, and hearing that Mr. Trotman was going to make a speech at the meeting the defendant wrote the letter for the purpose of supplying him with information. Mr. Trotman unwisely handed the letter to the Press, but under all the circumstances he (Lord Coleridge) asked the jury to say by their verdict that the defendant had not acted wrongly.

Defendant gave evidence to the effect that he acted in the matter perfectly *bonâ fide*, and had no desire whatever to reflect upon the honour of the plaintiff.

Other evidence having been given and counsel having addressed the Court, the jury found for the plaintiff, and assessed the damages at £100.

Judgment was entered accordingly, with costs.

Wilde v. Thompson.

In the Chancery Division of the High Court of Justice on Thursday last week, Mr. Justice Buckley had before him the case of Wilde *v.* Thompson. This was an application by the defendant, Prof. Silvanus Phillips Thompson, of Morland, Chislett Road, West Hampstead, that the statement of claim by the plaintiff, Henry Wilde, who resides at Hurst, Alderley Edge, Chester, should be struck out on the ground that it disclosed no cause of action; that it was vexatious and frivolous, and that it was an abuse of the process of the Court. The claim by the plaintiff was for an injunction to restrain Prof. Thompson from causing to be printed or published in his book on "Dynamo-Electric Machinery," or in any new edition, any statement attributing the invention of the generator of dynamic electricity known as the dynamo-electric machine to any person or persons other than the plaintiff. It was also claimed by plaintiff that the defendant should be restrained from making any mention of the plaintiff, his discoveries and inventions in his book on "Dynamo-Electric Machinery," or in any new edition, otherwise than in accordance with an agreed statement signed by the defendant about June 17th last. Damages were also claimed by the plaintiff.

Mr. Fletcher Moulton, K.C., and Mr. T. Clarkson appeared for the plaintiff, Dr. Henry Wilde; and Mr. Buckmaster, K.C., and Mr. Gray for Prof. Thompson.

Mr. Buckmaster, K.C., in opening the summons on behalf of the defendant, said the action was brought to restrain Prof. Thompson from referring in certain books, of which he was the author, to certain electrical machinery as being dynamo machinery without explaining that such was machinery invented by the plaintiff.

On Friday last, Mr. Buckmaster, K.C., in support of the summons, said the action was of an entirely new form, and he had never heard of such an action before. The ground of the action was that what Prof. Thompson had done and proposed to do injured the reputation of the plaintiff as an inventor.

His Lordship: Libel!

Mr. Buckmaster said it was libel, or, rather, was said to be. He should have to take his Lordship through the whole of the statement of claim in detail; but before doing so, it would simplify matters a little if he gave his Lordship a short statement as to the position of the plaintiff and the defendant in the matter in dispute. He did not know how far in making such a statement he ought to assume judicial ignorance of electrical facts.

His Lordship: Assume every ignorance.

Mr. Buckmaster said his Lordship probably knew that in 1831 Faraday made a discovery which had been the foundation of the whole of the dynamo-electrical machinery now used. He discovered that if you rotated a conductor between the poles of an ordinary permanent magnet, you induced a current of electricity to run along that conductor; and he also found that the same result was obtained if, instead of taking the permanent magnet, you took a magnet which was excited by some permanent battery. With that knowledge of this particular branch of electricity in that state, the plaintiff made the following discovery. He substituted in the place of voltaic cells which were used for the purpose of exciting an electro-magnet the apparatus that Faraday had himself used in the first instance in connection with his experiments. In other words, he took the permanent magnet, between the poles of which this conductor was revolved, as the means of obtaining the current whereby he excited the electro-magnet, between the poles of which was again revolved the permanent conductor, and again used the current so obtained by exciting another magnet, until you got the maximum possible result from the current you had first used.

Mr. Moulton: May I point out to my learned friend we cannot go into matters of this sort. Here in this statement of claim there is an allegation of a contract which we claim was to be performed.

Mr. Buckmaster said they would see about that directly. What the plaintiff said in his pleading was that that machine was so developed by him as to be the machine to which the word "dynamo" was properly applicable, and that to use that word with reference to the earlier machines of Faraday was to give to him (Faraday) the credit of having invented the dynamo, whereas in truth the credit ought to belong to the plaintiff. Plaintiff sought to restrain Prof. Thompson from making statements in his books which would have the effect of suggesting that Faraday invented and used dynamo machines. He also had another branch of complaint. He said that Prof. Thompson had a contract with him as to what Prof. Thompson should insert in his book. The second part of plaintiff's claim seemed to be to restrain Prof. Thompson from making any mention at all of the plaintiff in his book, except in the terms of the agreed proof mentioned in the statement of claim. He (counsel) submitted that such a statement of claim on the face of it disclosed no cause for action. One of the books in which it was alleged defendant was going to make statements against the plaintiff which the Court ought to stop, was a life of Faraday which was now being prepared for its second edition, and the other was a history of dynamo-electric machinery first published in 1884, and now being passed through the press for its 6th edition. The learned counsel then proceeded to read the statement of claim, which contained the following among other passages:—"The plaintiff has for many years been engaged in scientific researches, particularly in relation to electro-magnetism and its practical application to arts and manufactures, including the improvement of methods of generating electricity from magnetism." In the course of such researches the plaintiff had made divers discoveries and inventions of the greatest value and importance relating to the

generation of dynamic electricity. In the course of his researches in the years 1863 and 1865 the plaintiff discovered and practically demonstrated the principle of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and he invented a new and powerful generator of dynamic electricity in which his said discovery was embodied and practically applied by him with marked success to the production of the electric searchlight and to the electro-deposition of metals from their solutions, and had since been applied to other important purposes. The plaintiff's discovery and a description of his machine, together with an account of the researches which led up to them, were communicated to the Royal Society on March 26th, 1866, in a paper read before the Society on April 26th following. The machine was also exhibited before the Royal Society in March, 1867, and was the subject matter of patents taken out by the plaintiff in 1863, 1865 and 1867. The plaintiff's machine—of which the distinctive feature was a large electro-magnet excited on the principle of indefinite increase of the magnetic and electric forces through the agency of mechanical power—was subsequently designated by the term "dynamo-electric machine" or "dynamo," by way of distinguishing the machine from magneto-electric machines which generate electricity through the agency of ordinary permanent magnets, and which in no way embody, or depend upon, the plaintiff's discovery of the said principle. In consequence of the plaintiff's discoveries and inventions mentioned, as well as of other valuable and important discoveries and inventions made by him in connection with electrical science and dynamo-electric machines, the plaintiff had acquired a very high reputation in the scientific world as a discoverer and inventor, and in particular as the discoverer of the principle mentioned. In recognition of his high merits as a discoverer and inventor, the plaintiff had been elected a Fellow of the Royal Society, and an honorary member of the Institution of Electrical Engineers, and in the year 1900 was awarded the Albert Medal of the Society of Arts, and in the same year the honorary degree of Doctor of Science was conferred upon him by the Victoria University. The defendant, Silvanus Phillips Thompson, is a well-known writer on electricity and magnetism, and, in particular, is the author of a work on "Dynamo-electric Machinery," which has gone through five editions, and of a Life of Michael Faraday in the Century Science Series, which was published in 1901. The defendant has now in preparation, and intends shortly to cause to be printed and published, a new edition of the work on "Dynamo-electric Machinery." The defendant has falsely and maliciously written and published, or caused to be published, of the plaintiff the following:—

"(*a*) *Separately-Excited Dynamo.*—It was an obvious step to substitute for steel magnets electro-magnets excited by means of currents from some independent source, such as a voltaic battery. The *separately-excited dynamo* comes, therefore, second in the order of development. Though used by Faraday, this method did not come into acceptance until, in 1866, Wilde employed a small auxiliary magneto machine to furnish currents to excite the field magnets of a larger dynamo.

"(*b*) The first application of a dynamo to the purpose of electro-plating is due to Mr. J. S. Woolrich, who, in 1842, patented this use of a magneto-electric machine. Wilde, however, was the first to construct machines really fitted for the purpose when he invented the principle of using a large dynamo, the field magnets of which were separately excited by the currents of a smaller magneto-machine.

"(*c*) Faraday's Disk Dynamo.

"(*d*) The apparatus described in the fourth section comprised several forms of magneto-electric machines, that is to say, primitive kinds of dynamos.

"(*e*) Yet he took an interest in Mr. Wilde's description of his new magneto-electric machine."

In the passage (*a*) the defendant, Silvanus Phillips Thompson, means contrary to the fact that Faraday used the method of the separately-excited dynamo, and thereby deprives the plaintiff of being the first inventor of the separately-excited dynamo, and attributes such invention to Faraday.

In the passage (*b*) the defendant means contrary to the fact that a dynamo was applied to the purpose of electro-plating prior to the date of the plaintiff's invention of the dynamo-electric machine, thereby depriving the plaintiff of the credit of having invented the dynamo and attributing that invention to some other person.

In the words (*c*) the defendant means contrary to the fact that Faraday was, and the plaintiff was not, the inventor of the dynamo.

The passages and words (*a*) (*b*) and (*c*) were written and published by defendant, and were printed by William Clowes & Sons, Ltd., and published by E. and F. N. Spon, Ltd., in 1896, in the fifth edition of the defendant's work on "Dynamo-electric Machinery," at pages 48, 469, and 5 respectively.

In the passages (*d*) and (*e*) the defendant means contrary to the fact that the plaintiff was not, but some other person was, the inventor of the dynamo-electric machine, and the passages (*d*) and (*e*) were caused to be published by defendant in 1901 in his "Life of Michael Faraday," at pages 121 and 259 respectively.

The plaintiff having compained to the defendant of certain passages in his work on "Dynamo-electric Machinery," and of certain passages in the proof sheets of the new edition, wherein the credit of inventing the dynamo-electric machine was falsely attributed to other persons than the plaintiff, the defendant agreed in the month of May, 1902, to omit or modify in the new edition of his said work the passages complained of, and in lieu thereof to insert in his new edition certain other passages which, so far as they might have reference to the plaintiff or his invention of a dynamo-electric machine, should be approved by the plaintiff. Accordingly, on June 17th, 1902, the defendant signed and forwarded to plaintiff an agreed revised proof, or statement of the passages in question, containing the terms to which the plaintiff consented, and in which the defendant agreed to refer to the plaintiff's invention in the forthcoming edition of his work on dynamo machinery. The signed statement, or proof, contained three passages, in the following terms:—

"*Historical Notes.*

"(*a*) The term dynamo-electric machine was originated by the late Mr. Charles Brooke, F.R.S., as recorded in page 409, Vol. xv. of the *Proceedings* of the Royal Society in 1867, and its first application was to the machine invented by Dr. Henry Wilde, F.R.S., 1863—1865.

"(*b*) 'But, with the years 1865 to 1867, the era of the dynamo-electric machine was entered upon. As mentioned on page 1, this name was first given to the machine invented by Wilde'—meaning the generator of dynamic electricity invented by the plaintiff.

"(*c*) 'It was this machine'—meaning the said generator of dynamic electricity invented by the plaintiff—'to which in 1867 Brooke gave the name of dynamo-electric machine.'"

The defendant now declines to insert the three above-mentioned passages in the forthcoming edition of his work, but in lieu thereof threatens and intends to insert passages in which the plaintiff is deprived of the credit of being the first inventor of the dynamo-electric machine. By reason of the premises and the publication of the said libels the plaintiff is, and will be, injured in his reputation of a discoverer and inventor in the field of electrical science and electrical engineering.

Mr. Buckmaster, proceeding, said that that being the statement of claim, and the action being, as it necessarily must be, an action for libel and nothing more, there were one or two considerations which he ought to place before his Lordship as to how far such an action could on the circumstances in the statement of claim possibly succeed. One thing was certain that it was not a libel in the sense that it tended to hold up the plaintiff to opprobium, ridicule, or contempt. No one could suggest that any one of those statements had any such meaning. He knew no parallel for this libel. If any could be found it surely must be something in the nature of a libel against a man in his trade. It certainly was not a libel against a man in his private character. That being so, it was essential that special damage should be shown to support the action, and no special damage was suggested in the statement of claim. Of course, it was manifest that no special damage could be caused by such a thing as that complained of. This was an action brought before his Lordship, in which his Lordship had to act both as judge and jury. The first thing which had to be determined was whether or no the words complained of bore the innuendo they were stated to bear. That was a matter for the Judge. If the words were such that the Judge on reading them says they do not bear the innuendo they are said to bear, then there was nothing to go to the jury. But even if they did bear it, there still remained the question for the Judge to decide, viz., whether the innuendo was actionable. Here, he submitted in the first place, that the words complained of did not bear the meaning the plaintiff said they bore; and secondly, that if they did no form of action known could give relief. The learned counsel then referred to the fifth edition of defendant's book "The History of Dynamo-Electrical Machinery," and the definition on page 1, chapter 1, of a dynamo-electrical machine. He said that it was perfectly clear that that definition included a number of machines other than those of the plaintiff, because first within the terms of the definition would come those old machines of Faraday in 1831, where he rotated a conductor between the arms of a permanent magnet. As he understood the statement of claim, the plaintiff said that the word "dynamo" must be exclusively used as referring to a particular class of machine, and to use it otherwise was actionable. He must confess he could not see how the plaintiff was going to establish his case as to the alleged libels in his pleadings. Plaintiff had no copyright in the word dynamo. He did not even suggest that "dynamo" had any exclusive application to his machine, nor did he suggest that he ever invented the use of the word. It was extremely difficult to see how the word dynamo could be applied to plaintiff's machine and to nothing else. The word "dynamo" was short for "dynamo-electric machine." That was a machine in which one put in mechanical power at one end and out of the other got electric current. He (the learned counsel) could not see any suggestion in the word itself that would lead anyone to think that it had a special application to a machine which involved Dr. Henry Wilde's principle of the indefinite increase of the magnetic and electric forces from quantities indefinitely small. If all through these alleged libels instead of "dynamo" the defendant had inserted "machine," Dr. Wilde would not have had anything to complain of. He could only complain because in place of the word machine the defendant had used an equivalent to which he (plaintiff) objected. The learned counsel was unable to find any proprietary right known to law in the description of a machine or process. A proprietary right attached to certain words associated with commodities, but that one could understand. No man could assert even the right to the title of a book, unless he could show that the publication of a book under the same title led people to think that the book being sold was his own book under another name. He did not believe there was any proprietary right in any word, except in cases of marketable goods. Even assuming plaintiff went so far as to show that the had a right to the word "dynamo," he could get no further. When a man claimed relief in regard to the adoption by another person of the name of a particular product, he must show damage. No damage was suggested in this case. As to the alleged agreement that the statement of claim disclosed no binding legal contract, the mere fact of saying to a man, "I agree to do

a thing," did not make a contract. Prof. Thompson was very anxious, so far as he possibly could, to meet Dr. Wilde. Plaintiff made complaint to Prof. Thompson, and he agreed to modify. If, however, in writing a history of electrical machinery developments a person who only had been permitted to refer to inventions in a particular manner and not to refer to the discoverers, &c., it would be impossible to get an accurate account of the machinery or do full justice to the subject. He submitted that no defamatory statement had been made by the defendant in his writings; that there was no libel in the ordinary legal meaning of the word, and that there was nothing but a suggestion that the defendant had used a word in such a way that other people might have invented not Dr. Wilde's machine but a machine which was called by the name of "dynamo."

Mr. Gray followed on the same side, and submitted that the word dynamo had a meaning which applied to all machines which, being exercised by mechanical power, produced electric energy. Certain machines were described by the defendant in their historical position, and those machines were all capable of the definition of dynamo or dynamo-electric machine.

Mr. Fletcher Moulton submitted that the cause of the action was one which was properly alleged and formed a good cause of action. If the agreement in this case was "I will take no objection to your publishing these statements if you publish them in this form I submit," it was a perfectly legal agreement. It was a compromise of a dispute between Dr. Wilde and Dr. Thompson as to whether the latter was not going to take away from Dr. Wilde certain credit that he deserved, and in respect of which this action was brought. The two parties met, and they came to a compromise and signed the proof sheets. His client was bound thereby not to raise any objections so long as the statements were in the particular form agreed to, and the other person was bound to adhere to that form. The agreement was properly alleged, and it was for the Judge at the trial to find out whether or not this allegation was right, and whether or not there was a complete agreement in law. Proceeding, Mr. Moulton argued that the agreement had been properly completed. It was perfectly clear that this agreement was in the nature of a compromise. If the proofs were in these circumstances agreed and signed by the parties, it seemed to the learned counsel a remarkable thing that the Court should be asked to stop the action brought for the purpose of enforcing that agreement. Plaintiff did not claim a proprietary right in the word "dynamo." What he said was, "Here is an incorrect statement which injures my reputation. That is what I ask the Court to prevent being published." Supposing some work was attributed to a man who really had no merit to it, and one took it away from the man who ought to have the merit, that was a case in which the Court might interfere. It was a cause of action which plaintiff ought to have the right to raise. It would be a strong thing to say that a man might not even raise the question as to whether statements of such a kind were statements which gave a ground of action so far as concerned the restraining of the author from publishing them. The learned counsel thought it was not necessary for him to go into questions of science. The most amusing argument on the other side was that they must interpret a statement in a book by the definition that the author chose to give it. The question for his Lordship was whether there was no cause of action shown in the whole statement of claim. The parties, plaintiff submitted, agreed by way of compromise that the statement to be made in the book should be of a particular character, and actually got so far as to sign proofs. Then defendant broke that contract. Counsel contended that that was a cause of action properly stated, and one which was a good cause of action, because it alleged contract, and it alleged a breach. On these grounds, therefore, he submitted that the statement of claim could not be struck out.

Mr. Clarkson followed on the same side. He held that the statements by defendant were statements defamatory of the plaintiff's reputation as the inventor of the dynamo. Unless his Lordship was clearly of opinion that there was nothing disparaging and nothing which reflected on the plaintiff's reputation as an inventor, the action should be allowed to proceed. The statements in defendant's book practically held plaintiff up as a man who had been imposing on the scientific world as the inventor of the dynamo.

Mr. Justice Buckley, in delivering judgment, said:—In this case my difficulty lies in delivering judgment with becoming gravity. But I am bound in respect of the arguments addressed to me by plaintiff's counsel to endeavour to say a few words. I am afraid, however, that I cannot lift my judgment to a higher level than to stick up a couple of dummies and knock them down again. This plaintiff, in the first six paragraphs of his statement of claim, makes certain allegations, which he says are libels which will injure him in his reputation as a discoverer of this dynamo. When you come to analyse the statements of which he complains, they result in this: He says defendant admits and testifies to the fact that the plaintiff in 1863 or 1865 made a valuable invention. Plaintiff did not give it the name "dynamo," of the use of which he complains in this action, but, as he says himself in the second paragraph, that name was a subsequent designation which was given to it. By the paragraph which he seeks to substitute in the defendant's work, evidently he attributes the first use of that word to Brooke in 1867. There is no question raised at all by the plaintiff that the word dynamo was a word which he attached to his machine or which anybody else at the time that he made his invention attached to his invention, or was a name which conveyed his invention at all. He says certain passages in Prof. Silvanus Thompson's book, in which the word "dynamo" is used, are a libel upon him, because defendant made use of the word dynamo as describing something other than his (plaintiff's) invention. Plaintiff says that is libellous. I utterly fail to find any libel in the sense of any attack upon his personal character. There is no libel of contempt or ridicule or anything of the sort. On the contrary, Prof. Silvanus Thompson says:—"Wilde was the first to construct a machine really fitted for the purpose when he invented the principle of using a large dynamo, the field magnets of which were separately excited by currents from the small machine." A libel in that sense is obviously non-existent. Then there is another thing which is known as a trade libel. That is to say, so speaking of the goods of another person, which are, perhaps, inferior goods, as to convey that they are the goods of the person to whose goods a word has become attached. It seems to me on the plaintiff's own statement there is nothing of the sort in this case. He has no copyright in the word dynamo. He did not invent the word dynamo. The word dynamo does not express his machine, and I don't in the least understand in what sense he says that Prof. Thompson in using the word dynamo, for instance, in reference to Faraday, makes any attack upon the plaintiff, or raises any cause of action whatever. It seems to me with all due deference to the pleader to be pure nonsense. Then there is a second head in paragraph 7, so Mr. Moulton says, when he pleads contract. When you abbreviate and condense paragraph 7 it comes to this. Plaintiff complained of something. In the result defendant agreed to do something which plaintiff approved, and accordingly something happened. That is the whole of it. I can make nothing else out of paragraph 7. That is not contract. There is no consideration of any sort or kind. Of course a compromise as between parties will be consideration, and to support a compromise it is not necessary to show that the rights, or supposed rights, of terms which were compromised were real rights. You may compromise something, although, in fact, there was nothing to dispute about. But there is nothing of that kind alleged here. It seems to me this plaintiff is endeavouring to say that the law is as it is not—and it would be an evil day if it were so—that if one man makes a concession to another man for the sake of peace, the result is that there is a contract upon which the one can sue the other for specific performance or damage or something else. There is, in my opinion, no contract alleged, and after reading this statement of claim, I can find no possible cause of action. I make an order striking out the statement of claim and dismissing the action with costs.

Mr. Moulton: I ask leave to appeal. On that second point certainly we can allege consideration. If the point was raised that there was no consideration we could amend by alleging consideration. Legal proceedings had been threatened, and in consideration that they were dropped this arrangement was made.

His Lordship said Mr. Moulton might have leave to appeal, but he did not see why there should not be peace between the parties.

Mr. Moulton: Neither do I.

His Lordship: For that very reason I said at the outset that it appeared to me plaintiff made a valuable discovery, and defendant had recognised and stated that the plaintiff had made a valuable discovery. I thought that statement would probably produce peace between the parties. But if you want leave to appeal I will give you leave.

Mr. Moulton: I quite share your Lordship's feelings. Certainly I will do my best to make peace.

Wood *v.* Greville.

This was an electrical engineer's libel action, which came before the Lord Chief Justice and a special jury on Tuesday and Wednesday last. Plaintiff is a consulting electrical engineer and electrical contractor in Victoria Street, S.W., and defendant is a solicitor. The alleged libel was contained in a letter sent by defendant to the owners of some premises in Holborn, where he occupied some rooms, respecting the wiring of the said premises as carried out by plaintiff. His Lordship made two attempts on Tuesday to bring the parties together, but without success at the time; on the following day, however, when the Court met counsel intimated that a settlement had been arrived at. Defendant would withdraw all the charges that had been made against the plaintiff and pay the taxed costs of the action. His Lordship said that the defendant had taken a right and gentlemanly course, but he would have ruled had the case gone further that the occasion was privileged, and that the defendant was entitled to complain to his landlord; but it would have been for the jury to say whether in his letter he went too far in his references to the danger of the building, and to the way in which the work had been executed. He thought the defendant ought to pay the costs.

Electricity in Gold Mining.—Speaking at the meeting of the Mysore Gold Mining Co. last week, Sir Charles Tennant, chairman of the company, spoke as follows respecting the employment of electricity at the mines:—"We are glad to tell you that the electrical power at the mines is proving most successful, and it will unquestionably be a great benefit and a great economy to the company. In the first place we find that we secure by this means greater uniformity of power in its application to the driving of the batteries; hence better duty is obtained, and we may expect as time goes on to be able to reduce the amount of machinery driven by steam power, thus lessening the consumption of coal, which, as you are aware, constitutes so important an item in our accounts."

ROYAL COMMISSION ON LONDON TRAFFIC.

The Royal Commission appointed to inquire into the means of locomotion and transit in London held its first sitting on Friday of last week at the Caxton Hall, Westminster. Sir David Barbour, the chairman, presided.

The first witness was Sir Herbert Jekyll, chief of the railway department of the Board of Trade. He said he attended on behalf of that department to speak as to the present state of the law with regard to tramways and light railways. In the case of lines laid down in public roads, the powers of the Board of Trade were those conferred by the Tramways Act of 1870 and the Light Railways Act of 1896. Besides those powers there was also the procedure by private Bill in Parliament which was available for lines whether on the public roads or elsewhere. The Tramways Act applied to the whole of Great Britain, but not to Ireland. The word tramway was not expressly defined in the Act. He could not say that that had led to any confusion between tramways and light railways, as they were now practically identical. A provisional order did not give power for the compulsory acquisition of land, but as a rule, tramways were laid along public roads, and did not need to acquire land. The Act did not authorise a local authority to work its own tramways, but that power could be, and was, generally given by a clause in the provisional order. When no motive power was described, it was understood to be animal power. A local authority had power to purchase an undertaking at the end of 21 years at its then value.

The Chairman asked if that meant its scrap-iron value, to which Sir Herbert replied "yes."

In answer to a further question, Witness thought that it was a little hard on the promoters, and that a fairer way would be for the authority to buy it as a going concern. Continuing, witness explained the procedure under the Light Railways Act. An order issued by the Commissioners needed to be confirmed by the Board of Trade before it could become operative. As a rule, both local authorities and private promoters went to Parliament rather than to the Light Railway Commissioners, because Parliament could give what powers it thought fit, but in the other case the powers were strictly limited by the Act. The London County Council in promoting a tramway Bill in Parliament, had to get the consent of the borough councils through whose areas the line would run. In the case of a private promoter, the L.C.C. had an absolute power of veto. No doubt tramways had not developed in London as in other countries, due no doubt to the differences between local authorities, and there were no through routes mainly owing to physical conditions. It was quite a common thing for rival tramway schemes in the same area to be before the different tribunals at the same time, and it led to embarrassment sometimes. If all schemes were brought before one authority, there would be a much better chance of obtaining harmony. It was most desirable that there should be one authority to whom all such schemes would be submitted, and they would be able to select and co-ordinate. It was hardly likely that Parliament would hand over its powers in such an important matter, but a tribunal framed on the lines of the Railway Commission might be appointed which should consider schemes and grant a certificate. This certificate could be laid before Parliament, and if accepted by Parliament could go to a Joint Committee of both Houses to be considered. This would greatly simplify the present procedure.

In the course of cross-examination by various members of the Commission, Witness said he thought local authorities on purchase of tramway undertakings should take goodwill into account, and treat the concern as a going concern. A tramway and a light railway were generally the same thing, but under the Tramways Act the period for the repayment of loans was limited to 30 years. There was no such limitation in the Light Railway Acts, but the Commission generally inserted a period in the order, which, however, varied. There was nothing in the Acts to fix the number of cars which should run over a piece of tramline, but the Board of Trade might interfere on the question of public safety. The Light Railway Commissioners had regard to existing lines in considering schemes, and many promoters proceeded by private Bill because of Sec. 9, which caused an order to be refused if acute competition were proved. Consequently the promoters felt they stood the chance of having to commence *de novo*. No doubt the right of veto given to the local authorities was to enable them to supply their own tramway needs, and if local authorities used that veto for other purposes, there should be a right of appeal just as under the Electric Lighting Acts, which gave the Board of Trade the power to dispense with the assent of the local authority if that assent was improperly withheld. It would be reasonable for the local authorities to have a representative on the tribunal he had suggested. In the case of the promotion of London railways the question of finance must always be dominant. He knew that it was stated before Lord Windsor's Committee by a member of the L.C.C. that promoters asking for powers to construct a tube railway in a lucrative route should be held under an obligation to carry the railway to a sparsely-populated district, so as to facilitate the housing of the working classes, but such a condition might make the scheme impracticable because the promoters could not get the money. He thought the tribunal might initiate a scheme for London locomotion, taking into account the present conditions.

Col. Yorke, Chief Inspector of Railways under the Board of Trade, said that in 1901 he visited Budapest in connection with the Ganz system, which was being installed on an Italian railway, and he was instructed to turn his attention to what was being done with regard to tramways and subways. He reported on the Paris shallow railway, and last year he visited New York and Boston, where they had dealt with the problem in a comprehensive way. In New York and Boston the question was dealt with by a Transit Commission, but there were no competing subways in either town, although there were competing lines on the surface and overhead. The subways were constructed at the cost of the municipalities, and then they were leased for working. His opinion was that in London it was desirable that some method should be devised for securing continuity of methods. They should first initiate a general scheme, and try and get it carried out. He thought a tribunal might be constituted, possessed of most of the powers vested in a Parliamentary Committee, and with jurisdiction similar to the Light Railway Commissioners, while the Board of Trade could continue to be responsible for inspection for the safety of the public. He had not considered the question of jurisdiction where a portion of a railway was in London and part out. Something would have to be settled, but he saw no insuperable difficulty. His opinion was that tramways in narrow streets were no benefit to rapid locomotion. He considered a street was narrow when there was only room for a single line, and the difficulty was greater when they were unable to get 9 ft. 6 in. clear from the curb. But the suitability of a street for a tramway also depended on the traffic in it. In London the streets were sufficiently wide, but the question arose as to the amount of traffic already existing in the streets. If there was much traffic in a street, a tramway might prove an obstruction, and in cities like Manchester, Glasgow, and other places they found a long procession of cars proceeding down a street, which caused an obstruction. In Boston they had subways in the congested districts down which the tramways went. That could be done to a limited extent in London, and, in fact, the L.C.C. were constructing a tramway subway in the new street from Holborn to the Strand. He was strongly opposed to tramway cars converging on to and collecting in the same street. With regard to the systems used, he considered that, in a city like London, the overhead trolley system, with its necessary safeguards, would be intolerable. The congestion in the streets of London was caused by the general volume of traffic, and the multiplication of tramways was dangerous, inasmuch as it led to the rule of the road being disregarded. Unless they could get speed, it appeared to him to be a waste of money to construct tramways, and in congested districts they should be carried underground. With regard to the centre of London, he did not think there was room for many more surface tramways than already existed. Where there were opportunities for rapid locomotion tramways were desirable, and he thought the Thames Embankment was most suitable for tramway purposes. No doubt the existing railways in London could not carry their traffic. With regard to the tubes and subways, they could only have the effect of decreasing to a small extent omnibuses and cabs, because the tubes simply brought in the workers, who did not create the street congestion. The congestions were caused by the slow and fast traffic in the streets all mixed up together, and he did not think it practical to stop the heavy traffic between certain hours as it would add to the cost of cartage. Coming to tube railways, witness advocated increasing the diameter of the tubes. Personally, he did not think there was room for many more tubes beyond those suggested, but one might be constructed from Hammersmith to Hyde Park Corner with a subway under Hyde Park. Preference should be given to schemes radiating to the outside districts, and they should be brought to the surface in the suburbs, and should be extended either as tramways or electric railways. There was no doubt, however, that the suburban lines of the big railways would be electrified. After all, however, the need would still remain for wider streets and new thoroughfares. The Commission adjourned.

SOUTH AFRICAN NOTES.

[From our Special Correspondent at Johannesburg.]

Bloemfontein, O.R.C.—At a meeting of the T.C. last week a resolution was moved to the effect that the time had come to consider the question of the provision of electric tramways for the town, in view of the large amount of surplus power now available, and the subject will be thoroughly gone into at an early date.

Bloemfontein Telegraphic Arrangements.—Arrangements have been made to give Bloemfontein station direct telegraphic communication with Capetown. Messages will pass as before, through Kimberley, but will go through the station instead of having to be re-transmitted. It is intended, as soon as the necessary material arrives, to re-build the lines throughout the Orange River Colony, thus securing a much improved service. Since the conclusion of the war nearly 2,000 miles of line have been laid throughout the Colony.

Standerton, Transvaal.—The Health Board has resolved to call for tenders for an electric lighting installation for the town.

Klerksdorp, Transvaal.—It is proposed to institute a telephone service for the town.

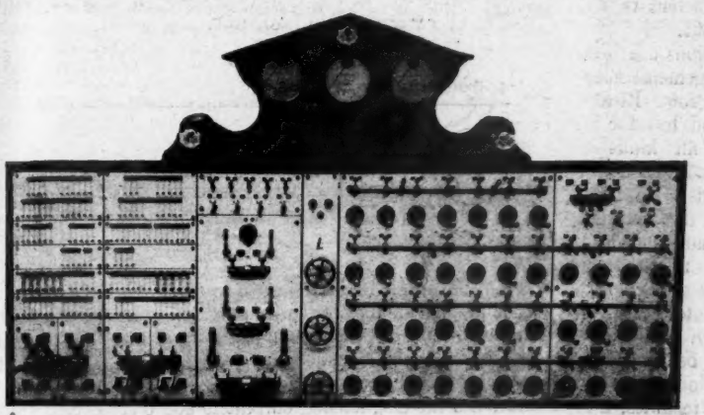
Maritzburg, Natal.—The C.C. has resolved, on the recommendation of the Tramways Committee, to order six eight-wheeled single-deck cars. In accordance with the consulting engineer's recommendation, it was decided not to adopt the sliding bow method of transmitting current to the cars, but to utilise trolley wheels as in Durban.

Johannesburg Telegraph Department.—Mr. Taylor-Fox, chief of the local telegraph department, was entertained at a dinner and presented with an illuminated address by the members of the staff prior to his departure for Pretoria to assume control of the office there. Mr. Brown, the P.M.G., in a speech, said he thought

the public did not quite understand the state in which the wires of the department were handed over to them. They had had such things as 10 miles of copper wire, and then a few miles of barbed wire. He was not quite sure whether they did not have some cable hawser! Yet the public wondered why the telegrams did not go promptly! They were going to do their level best to give the best service in South Africa, and as good a service as there was in the world.

Lourenço Marques.—Work for the tramways is being rapidly pushed on with, and already the poles are being deposited along the route.

Johannesburg Tramway and Lighting Scheme.—The Chamber of Trade has been discussing the Council's scheme. Its members are of opinion that the revenue has been greatly over-estimated in the report of Messrs. Mordey & Dawbarn, of which an abstract appeared in the Elec. Rev. for February 20th. After a conference between a sub-committee of the Tramway Committee and the Chambers of Trade and Commerce, it was decided to recommend the Tramway Committee to issue specifications simultaneously in London and Johannesburg, and that tenders be called for both f.o.b. and delivery in Johannesburg. The following dates were also decided on:—That the dispatch of specification by mail to Johannesburg for rails, tie-bars, points, &c., is to take place on March 27th next, and the issue to be made simultaneously in London and Johannesburg on April 8th. The closing date for the receipt of tenders in London is May 26th, and the report on the tenders received is to be dispatched on June 5th. Instructions to place the order will be sent on July 6th for these items, and for the permanent way on August 31st.



The Switchboard at the New Theatre.

The time allowed for the commencement of delivery of the rails, &c., is five months, and the time in which the permanent way is required to be completed is 14 months. The work is to be started on December 6th, 1903, and completed on December 31st, 1904.

Umtata C.C.—Further details are just to hand with regard to this scheme, and it appears that the municipality proposes to utilise the power of the Umtata Falls, which are about 2½ miles further down the river than the town, for the generation of electric current. For the water supply the water will be drawn from the river close to the town, which forms the north boundary of the township. This will most likely be done by means of electric pumps. The Council has no fixed scheme, the competing contractors preparing their own plans, specifications, &c.

The Witwatersrand Mechanical Engineers' Association.—The above Association is now discussing papers on "Central Power Stations for Gold Mines." Although this Association is a purely mechanical one, in view of the enormous part electricity will play on the above subject in the future, it has invited the electrical engineers of the Rand to join in the discussion, and some important papers are expected. They have recently finished a lengthy discussion on "Winding from Great Depths."

Kimberley C.C.—An amicable understanding has been arrived at between the Town Council and De Beers Co. with reference to the supply of electric light.

The company will furnish current on the basis submitted at the annual meeting last December, which, it will be remembered, was the offer to supply current at 6d. per unit, with a possible reduction to 5½d. in the event of coal becoming cheaper.

THEATRE INSTALLATION.

We recently had the pleasure of inspecting the electrical installation at Sir Charles Wyndham's New Theatre, St. Martin's Lane, for which energy is supplied by the Charing Cross and Strand Electricity Supply Corporation at 100 volts, the three-wire system being split outside the theatre, so that there is never a difference of potential of 200 volts in any part of the house.

The whole of the auditorium and stage are divided into two distinct and separate circuits, alternate points being on different circuits, which run separately back to the *two* main distribution boards, where they are connected through throw-over switches to two distinct services from the Charing Cross Co., one being from ordinary network, the other from the special theatre main, which is fed from separate plant. Should either supply fail, only one-half of the stage and auditorium is affected, and then only until the half that has failed is thrown over on to the other supply.

There are, approximately, in the auditorium, 350 lights, and five outside double-carbon Brockie-Pell 10-ampere arc lamps.

On the stage provision is made for over 1,000 lights and 13 arc projectors.

The whole of the stage wiring is repeated four times over in white, amber, red and blue; every alternate point on the stage is arranged similarly to the auditorium, from different services.

The arrangements for controlling the stage lighting have been specially designed for this theatre. The whole of the prompt side of the "flies" has been given up to the electrical plant. The main stage-board, the dimmer gear, the dimmers themselves, the arc lamp resistances, the controlling resistances for the ventilating fans being all situated thereon, so that the engineer-in-charge has never to move from the fly-rail during the performance should any hitch occur, an improvement on the usual method, where the dimmers are situated in fire-proof rooms some distance from the board, which is usually above the stage on a platform, the resistance room being under the stage.

The board, which we illustrate, is capable of dealing with a current of 1,200 amperes, and is made in three sections (1) carrying the main throw-over switches and circuit fuses, (2) being a master panel for main controls, and (3) the panel carrying local switches with controlling gear for the resistances.

The switches for the coloured lights are designed in such a way that any single switch can be operated independently, or the whole line worked simultaneously by means of a connecting link. Any line vertically is the same point, that is to say, the first switch in each of the four horizontal lines will be the float, the second switch will be the proscenium, and so on. Horizontally, all switches in a line are the same colour, the first line being amber, the second white, the third red, and the fourth blue. Under each switch is a small hand-wheel, controlling the dimmer of that particular circuit. All wheels of the same colour are capable of being locked by a simple and instantaneous movement on to a common gear, so that they can be moved simultaneously by a common hand-wheel. A special feature is connection with these wheels is, that if any single wheel is locked on to the common wheel, any other wheel can be picked up after the first is started, and when the first wheel comes to its stop the main wheel can still be rotated until the second wheel is brought to its stop by means of an automatic releasing arrangement, a unique feature in controlling gears.

The dimmers are of the Lyons liquid resistance type, and mounted on insulating trays.

The lighting of the dressing rooms has been carried out on the double supply system, with throw-over switches similar to the other parts of the building.

The whole of the wiring is in screwed welded steel conduit, and was carried out by the Brush Electrical Engineering Co. Messrs. Edison & Swan manufactured the switchboard and gearing for the stage control. The battens were manufactured by the General Electric Co., and are their special copper strip type, with porcelain insulators. The float is of special design, lamps being mounted on the cover of two continuous cast-iron troughs, which carry the cables supplying them. The crystal fittings, including the main auditorium light, have been supplied by Messrs. H. C. Osler, of Oxford Street. The whole of the work has been carried out to the designs and specifications and under the supervision of Messrs. Owen Lucas & Pyke, consulting engineers, 39, Victoria Street, S.W.

CORRESPONDENCE.

[A Note to Our Correspondents.—We shall be glad if, when our readers wish to criticise or otherwise comment upon articles which have appeared in the Review, they will not delay sending in their communications. Too frequently it happens that important letters come to hand just as we are going to press with the following issue. Such letters have, therefore, to await publication until a fortnight after the criticised article appeared, and the correspondence drags along.

Owing to the large amount of matter which has to be dealt with nowadays, and to our having to print much earlier than was formerly the case, we beg to intimate that all letters which are received after 10 a.m. on Wednesday morning will have to be held over until the next week's issue.

If all others who, from time to time, send us news for publication will also bear in mind that everything should reach this office at the earliest possible moment, they will greatly assist us.—Eds. Elec. Rev.]

Patents for Sale.

In No. 1,318 of the Electrical Review of February 27th we read the correspondence "Patents for Sale." We beg to call your attention to our company, as we presume that in your country there are also many inventors who would wish to turn their foreign patents to profit.

A Company for the Introduction of Inventions has been established under the co-operation of the Allgemeine Elektricitäts Gesellschaft, of Berlin, and the Profs. Riedler and Stumpf, of the Technical High School, and has for its object the introduction of inventions of all kinds of mechanical and electrical machinery. This institution will be of a great advantage, especially to English manufacturers and inventors, for it is a well-known fact that the negotiation of patents in foreign countries is surrounded by many difficulties for want of the necessary relations, or because the patent agents commissioned with the exploitation of inventions have not the necessary interest in, or commercial appreciation of, the inventions. Of course, in a far more successful manner can inventions be turned to profit by a company who have business relations with the largest factories in the different branches of technics, and who derive their strength from making this business their speciality. Patentees who would wish to exploit their patents in foreign countries should not fail to apply to the Company for the Introduction of Inventions—

Gesellschaft zur Einführung von Erfindungen m. b. H., 22, Schiffbauerdamm, Berlin, N.W. 6.

Berlin, N.W., *March 14th*, 1903.

Municipal Electricity Stations.

Referring to your article in last week's issue upon Sir Henry Fowler's Parliamentary return, and to your criticisms on the finances of municipal undertakings, I think it only fair to the municipal authorities that you should admit their low construction costs, which are about 15 per cent. below those of the companies for a given station capacity and number of lights. Their average costs also are less.

The majority of the municipal stations which are not covering expenses are comparatively new, and if they would overcome their weakness to supply cheap road lighting, they would soon set their finances straight.

As to the question of providing a depreciation and antiquation fund, I think the effect of neglecting this wise provision would fall far more seriously on the stockholders of a public company than upon ratepayers; for in 25 years the municipal stations will be fully paid for, and if electric light in its present form is no longer needed, no one would be ruined by the sale of the works at old metal value.

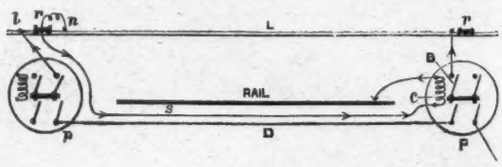
David Stevenson.

Westminster, *March 16th*, 1903.

Falling Trolley Lines.

Considering the number of patents taken out or applied for, all purporting to lessen the dangers from live trolley lines falling upon the streets and roadway, it is rather surprising to find the majority of overhead systems still compelled to rely on a *maximum load cut-out* for this purpose. This switch must act before the power is cut off the broken or faulty section, which means (unless under favourable conditions of load) a very heavy short circuit current before the switch opens.

We are daily informed by some lucky individual, who has been fortunate in discovering the startling fact, that this is the age of labour- and life-saving devices and that automatic machinery has reached a state of perfection. Why, then, is it so difficult to devise a reliable system of automatic switches that depend for their action, not upon an overload or short circuit current, but upon the discontinuity of the line? I have read with interest the description of a switch designed to be fitted in the line which is actuated by the weight of the falling trolley, but do not consider the break a safe or reliable one. Is it not possible to fix switches in the power station or at feeding points, designed to cut the power off *immediately* a break occurs in the continuity of the section fed from that point, such switches to be installed in conjunction with maximum breakers? For instance, suppose P in the accompanying diagram is a feeding point supplying power to a section of the overhead line L, and *p* another point connected through a distributor D and supplying section *l*; *r r* are section insulators.



A small shunt lead S is drawn in along with distributor D, or it may be an insulated wire stranded with the distributor and connected to the line L as shown at *n*. In series with this lead a high resistance energising coil C is connected and operates automatic switch B. Whenever a break occurs in section L the magnetising current in coil C ceases and switch B opens in the usual way. Probably this or a somewhat similar arrangement has already been tried and found deficient or too expensive. In wet or snowy weather surface leakage at section insulators would tend to mar its reliability, but this could be overcome. I would like, through this column, to obtain information upon the best method at present in use. Maximum load cut-outs have the disadvantage of creating miniature thunderstorms or a display of fireworks before the wiry and elusive de-watts are subdued, the result being alarming reports from *eye witnesses* who have been *unable to see* on account of the blinding flashes and peculiar contortions of the charging monster. In fact, there are still a few *living* heroes who have boldly (after the fireworks had subsided) placed it upon the rail and *saturated* the earth with its life blood.

Truly a savage proceeding in this age of intellectual refinement.

J. C. Stewart.

Partickhill, *February 10th*, 1903.

Electro-Metallurgical Problems.

In reply to Dr. Steinhart's remarks in your last week's issue upon my article on "Electro-Metallurgical Problems," I would point out that the manufacture of ferro-chrome and ferro-manganese by the Stassano process was given simply as an instance of the electrical production of these alloys; it was, perhaps, unfortunate that a more fully-developed process was not chosen as an illustration. Tungsten powder, produced non-electrically (which I was not aware had a large application in this form), can, I believe, be fused together to a coherent mass in the electric furnace without carbon, in which case, of course, no carbide is formed; but this, however, is not the idea I originally intended to convey. With regard to the skinning of tin scrap and the deposition of tin from alkaline solution, my remarks were, perhaps, based somewhat upon personal experience, and I have to thank your correspondent for pointing out that they were misleading with regard to this and the tungsten industries.

Alec A. Beadle.

Electrically Operated Printing Machinery.

With reference to the correspondence which appeared in your issue of the 27th ult., we have delayed our reply to Mr. Eck's letter pending an opportunity of making some actual tests, which has now been afforded us by the courtesy of Messrs. Lloyd.

We are pleased to note that generally we are in accord with Mr. Eck as to the main advantages of the "Ward-Leonard" system, but we are not in accord with him as to the efficiencies. In the first place, we would suggest to him

that an error has crept into his calculations of the efficiency of the "Ward-Leonard" system opposite the 75 per cent. and 90 per cent. speeds. Further, we were not able to agree with Mr. Eck that the speed at which Messrs. Lloyd's press was principally run was 90 per cent. Consequently, we had a Vulcan recording instrument put in circuit with the machine to ascertain the speed at every instant of the whole night's run. From this we find that by far the larger proportion of the run took place at 80 per cent. of full speed, whilst the speed never reached anything like Mr. Eck's figure, 90 per cent.; in fact, the maximum recorded was only 82 per cent. The length of the charts giving the readings of the recording instruments is 20 ft., so that we fear you would have difficulty in reproducing them, but they are at your service if you wish to inspect them.

This fact, of course, has a very important bearing on the efficiency of the system, inasmuch as at the 80 per cent. speed with the ordinary rheostat control, there would be 20 per cent. of the whole energy wasted in resistance, whereas, according to our tests, the efficiency of the "Ward-Leonard" system is 84·2 per cent., and of "Electra's," according to Mr. Eck's figures—it lies between 68·5 and 72 per cent. Thus, under the conditions at Messrs. Lloyd's, the efficiency of the "Ward-Leonard" is 4·2 per cent. better than the rheostat control, and about 14 per cent. better than "Electra's."

We believe it will be found that the tests which we have made at Messrs. Lloyd's represent fair average practice; as we have already pointed out, it is our experience that in the case of large printing machines, it is always desirable to have some margin of speed, while it is customary to run—generally speaking—well below the maximum speed.

Mr. Eck says that, since this system was put on order for Messrs. Lloyd, viz., two years ago, he believes there are now better systems available, and asks for results of the Holmes-Clatworthy and Bullock systems. These systems have been in use, as we understand it, considerably longer than two years, and we shall be interested to know what is the improved system which Mr. Eck refers to.

Geipel & Lange.

Earthing Device for Overhead Wires.

Under the heading "Notes on Management of Tramway Undertakings" which appeared in your last issue, Mr. Wordingham refers to an earthing device for overhead wires. He evidently has not seen the device in operation; therefore his theory of what would happen when the glass was broken is chimerical.

On several occasions at St. Helens the glass of one of these devices, fixed on our tramway system, has been broken by a walking stick or a truncheon, and, without the slightest flash, has effectually cut off the section feeder, supplying 300 to 400 amperes.

I shall be pleased to demonstrate the fact at any time to any gentleman interested in tramway matters, notwithstanding the evil results prophesied by Mr. Wordingham.

E. M. Hollingsworth.

St. Helens, *March 16th*, 1903.

Wiring of Buildings.

The letter from your correspondent "Inspector" in this week's issue is both interesting and amusing. Interesting as regards the tests he obtained on the job with the splendidly finished main switch, &c., and amusing as to the recommendations he gave to a supposed foreman, matters which surely are well known by everyone having anything at all to do with installation work, and which are always carried out by everyone except the jerry wireman. One point I would like to ask, Where is it customary for an inspector of a supply company (as I presume your correspondent is) to make these recommendations, to disconnect the main switch, and to test each circuit separately? I have had dealings with several supply companies in various parts of the country, and have never heard of it before, but I have always been careful that the test has been as stipulated in the wiring rules before asking the inspector to come in, and may be that is the reason. I cannot but think that if inspectors do as much as your correspondent did, they will earn the 10s. 6d. about which several of your correspondents have complained.

As regards the test under notice, "Inspector" seems to think that the leakage was in a great measure due to the slate, but I would point out that, although slate is a big sinner in this respect, it does not show itself unless faulty circuits are connected to it. Of course, this only refers to leakage to earth; leakage between poles depends as regards the slate on the distance dividing the poles. I will give you a case that occurred with me two years ago. Testing at a distribution board consisting of eight 10a. circuits, I obtained a very bad test. I therefore took out the fuses, and obtained something like the following:—8Ω, 7·0Ω, 5·0Ω, 4·0Ω, 1·5Ω, ·75Ω, ·2Ω, ·1Ω. I then disconnected the ·2Ω and ·1Ω from the board, and obtained nearly three times the amount on the next two circuits and an increase on the remainder, clearly showing what I stated above; the leakage from the faulty circuits through the slate had brought down all the others, those nearest being most affected. "Inspector" says, do not use slate; if not, what then?

H. B. Bingham.

BUSINESS NOTES.

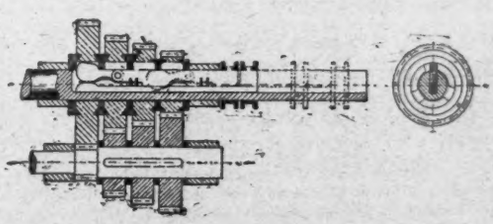
Electrical Wares Exported.

Week ending Mar. 18th, 1902.		Week ending Mar. 17th, 1903.	
Adelaide. Teleph. cable. Value	£274	Adelaide. Teleg. cable Value	£89,400
Alexandria	21	Alexandria	68
Amsterdam	130	Amsterdam	121
Barcelona	17	Antwerp	23
Beira. Teleg. mat.	2,229	Bombay	315
Bombay	458	,, Teleg. cable	101
Bremen	125	Brisbane	761
Buenos Ayres. Teleg. mat. ..	50	Buenos Ayres	149
Calcutta	150	,, Teleg. mat. ..	1,428
Cape Town	460	Calcutta	1,000
Christchurch	21	Cape Town	701
Colombo	90	,, Teleg mat. ..	2,080
Constantinople	23	Chinde. Teleg. apparatus ..	410
Copenhagen. Teleg. wire ..	107	Durban	269
Durban	241	,, Teleg. mat.	1,926
East London	21	East London	1,183
Fremantle	56	,, Teleg. mat. ..	625
,, Teleph. mat. ..	278	Gibraltar	252
Gibraltar	260	Hamburg	37
Halifax	35	,, Teleg. cable.. ..	100
Hong Kong..	192	Karachi	89
Melbourne	461	Labuan	129
Nagasaki	290	Melbourne. Teleg. mat... ..	2,192
Otago..	120	Otago	311
Paris	30	Paris. Elec. brougham.. ..	300
Perth..	390	Perth	186
Port Elizabeth	21	Singapore. Teleg. mat.	116,640
Shanghai	48	Sydney	336
,, Teleg. wire	119	Wellington	15
Sydney	723	Yokohama	329
,, Teleg. wire	1,990		
Wellington	425		
Total ..	£9,275	Total ..	£215,536

Foreign Goods Transhipped.

Genoa. Elec. goods .. Value	£85
Gothenburg. Elec. apparatus..	35
Total	£50

New Change-Speed Gear.—Messrs. The Langdon-Davies Motor Co., Ltd., are introducing a perfected arrangement of their change-speed gear for motor-cars. It will be remembered that this company had on view at the Crystal Palace Show a gear in which the wheels were always in mesh and were respectively locked to the shaft by means of a sliding key pushed outward by a spring,



enabling any change to be made from the lowest to the highest speed without engaging intermediate gears. The latest and most important addition consists in a second or locking key sliding under the original key and giving a positive action. In the diagram will be seen the lower or bevel shaft with the gear wheels keyed on and engaging with their respective fellows on the sprocket shaft. The latter wheels are bored slightly larger than the sprocket shaft and run clear of it on gun-metal floating collars with the objec- of pre-

venting any abrasive action between the edges of the keyways in the shaft and wheel after wear has taken place. A deep slot is cut in the sprocket shaft, which is of extra large size. In this slot the two keys slide, one above another, the upper one having a spring catch of large size, and easily accessible and renewable, which rises, engaging with the slot in the particular wheel under which it is placed. The second, or under-locking key, when pushed in, supports the catch in position and precludes the possibility of any accidental slipping out, which, on those cars fitted with purely spring catches, has frequently given rise to awkward situations. The catch is shown in gear with the low-speed wheel in the diagram. The two keys are worked by collars sliding on the sprocket shaft, the motion of the collars being controlled through flexible connections by a single handle, which is turned to operate the catch and pushed down to lock the gear. The gear, which runs in oil, gives speeds of 3½, 7, 12 and 18 miles per hour with a normal engine speed of 800 revolutions per minute. A striking feature of the gear is its simple construction, and the speed with which it can be pulled to pieces and re-erected.

The Staunton Speed Indicator.—We have received from Messrs. Staunton & Co., of Excelsior Works, Bethnal Green, E., a circular describing a new type of speed indicator for motor and tramcars. It is operated from a self-contained gear on the hub of one of the front wheels in the case of a motor-car, through a length of flexible steel shafting, and will indicate the total number of miles travelled, rate of speed, up to 30 or 60 miles per hour, register automatically the maximum speed travelled during each 110 yards, or further distance, and can be arranged to record the highest speed reached at any one time. It is a handy little instrument, although we fancy the majority of motorists will, in the present state of the law relating to speeds, prefer the omission of the latter indication.

Belliss Engines.—Among the contracts which have been booked recently by Messrs. Belliss & Morcom, Ltd., are the following:—

Glossop (Messrs. Edmundson's Electricity Supply Corporation, Ltd.).—One 70-H.P. engine for coupling direct to a Parker dynamo.

Caterham (Messrs. Edmundson's Corporation).—Two 70-H.P. engines for coupling direct to a G.E.C. (1900) dynamo.

Tokio.—Two 50-H P. engines for driving Brush dynamos.

Christchurch, N.Z.—One 180-H P. engine for coupling direct to a Parker dynamo.

Larne Electric Light Works (*Co. Antrim*).—One 110-H.P. engine for direct coupling to a B.T.H. alternator.

Gibraltar.—One 250-KW. and two 150-KW. engines direct-coupled to alternator and dynamos; also boilers, condensing plant, and accessories complete.

Blast Furnace Gas.—It is satisfactory to note that British ironmasters are waking up to the value of the possible results in economy, convenience and safety, obtainable from the rational use of their blast furnace gases. The Blast Furnace Power Syndicate, Ltd., has received amongst other important instructions an order for a Thwaite-Gardner blast-furnace gas-treatment plant, for the Yorkshire Iron Co., Ltd., to deal with over 2 million cb. ft. of gas per day, which is to be utilised for supplying a gas-driven blowing engine.

Foreign Electrical Imports.—Returns just issued show that the value of the foreign electrical goods and apparatus (not including electrical machinery) imported into this country during the past month amounted to only £50,258, as compared with £52,777 in the preceding month, and £54,516 in February, 1902. For the two months ending with February last, the returns show a total of only £103,035, as against £117,820 in the corresponding two months of 1902.

Auction Sale.—Messrs. P. Huddleston & Co. will sell by auction on 26th inst., at 12 o'clock, at 16, Long Millgate, Manchester, a quantity of electrical plant, comprising cables, motors, motor starters, switches, switchboards, arc and incandescent lamps, voltmeters, ammeters, telephones, &c., &c.; also some brass and copper fittings, &c. See our advertisement pages to-day.

For Sale.—The Dublin Corporation wants offers for four water-tube and two dry-back marine boilers; alternators, dynamos, transformers, meters, &c.; also for five motor lorries. See our advertisement pages to-day.

Walsall Tramways.—"Phono-Electric" trolley wire is being supplied for the Walsall Corporation tramways by Mr. F. Z. Maguire, of Warwick Court, W.C.

Rosling & Fynn, Ltd.—A statement of affairs has been issued by Mr. W. M. Gray, accountant, of Bradford, the liquidator of Rosling & Fynn, Ltd., electrical engineers, Trafalgar Works, Thornbury, Bradford. The statement shows that he has sold the plant, stock-in-trade, and freehold works at Thornbury for £13,100. The book debts of £1,479 are estimated to produce £925, giving total assets of £14,025. To set against this are debentures for £11,380, leaving a balance of £2,645, or, less claims for rates, apprentices' premiums, &c. (£411), £2,233. There are unsecured creditors for £5,182, to meet whose claims the trustees will thus have £2,233, leaving a deficiency of £2,948. As the unsecured creditors will not receive payment of their claims in full, there will be no surplus assets for division amongst the shareholders of the company. The estimated balance of assets, £2,233, will be divided amongst the unsecured creditors after payment of the expenses of liquidating the estate.

Fire Prevention.—The British Uralite Co., of London, has received an order from the London Hospital to replace matchboarding with uralite in the wards, to minimise the risk of fire.

New Lathe.—Messrs. Selig, Sonnenthal & Co., of 85, Queen Victoria Street, E.C., are bringing out a new patent "Universal Monitor Brassfinishers' Lathe," for which many advantages are claimed. The headstock is fitted with a circular disc carrying four copy screws of different pitches, anyone of which can be instantly brought into operation; a set of corresponding dies is similarly fixed on a turret, and the chasing slide carries a turret fitted with four chasing tools, so that all the different threads can be cut one after the other, with great rapidity, either right or left hand.

Standard Motor Construction.—The design of the small motor for industrial purposes has, during the last few years, assumed a premier position in the electrical manufacturer's somewhat varied field of employment. If anything, this section of electrical work had been neglected, at any rate as far as systematic production was concerned. The many inducements, however, which convenient and cleanly motive power, coupled with decreasing charges for energy, now hold out to the small power user, have emphasised the growing need for up-to-date motor manufacturers, who are prepared to devote their whole attention to this branch. In this connection it is interesting to note that the Rhodes Electrical Manufacturing Co., of 70 and 71, Bishopsgate Street Within, E.C., are devoting their time and energy solely to the production of motors in sizes varying from 1 to 40 H.P. inclusive. Their up-to-date knowledge of this class of work was obtained from over the "herring pond." Their plant and tools are specially adapted for their work, and as a result of the specialised system of manufacture which is adopted, the men become expert in their individual spheres of labour and a high quality of work results. The firm anticipate no difficulty in producing machines of any speed, voltage and size, coming within their range of sizes, in from 7 to 10 days, and they are in a position to deliver immediately from stock any standard machine. Special attention has been bestowed on their design, and has resulted in a machine possessing marked commercial characteristics, among them being simplicity, rigidity, standardisation, and efficiency. The armature is built up of former-wound coils on a laminated toothed core. The coils are firmly secured in position by steel bands, and any individual coil can be removed or replaced with ease. The commutator is composed of best hard drawn copper segments, insulated with pure mica and assembled under hydraulic pressure to ensure absolute solidity. The frame, which also forms the magnet yoke, is of high permeability iron or steel, and the pole cores—circular in shape—are of annealed wrought-iron, or high permeability steel, fitted with extended laminated pole tips, encircling a large proportion of the armature surface. The field coils are also former-wound, and the bearings, which are of solid gun metal, and the brush gear are of up-to-date design. It is interesting to note that the makers

R.E. Motor Fitted with Speed Reduction Gear.

have succeeded in eliminating the humming sound usually emitted by motors and other electrical machinery when running. The motors are thoroughly tested, both for full and overload running, over a considerable period, and for insulation, a high pressure test of 2,500 volts being given between the windings and frame. The standard voltages are 115, 230, and 500 volts, and the standard speed reductions 6 to 1, 5 to 1, 4 to 1, and 3 to 1. The works are situated at City Electrical Works, Bradford; all business inquiries are dealt with in London. Leeds agents have been appointed in Messrs. Beanland, Perkin & Co.

Catalogues and Lists.—The Lahmeyer Electrical Co., Ltd., have sent us an illustrated pamphlet of polyphase asynchronous motors manufactured at their Frankfort works.

A list of "Panel" wall sockets has come to hand from Messrs. Davies, Kent & Stewart, of Berners Street, W.

Some capital catalogues have been sent to us by the Fairbanks Co., of City Road, E.C., dealing respectively with the Skinner chucks, the Reed pipe-fitters' tools, and the Fairbanks power hammer.

A little booklet has reached us from the National File Co., of America, whose British depôt is at Leeds. It gives some "Facts about re-cut Files."

Messrs. Siemens Bros. & Co. have brought out a list containing a large number of interesting and well-executed illustrations of electric rock drills. The electric percussion drill and the electric rotary drill are both described, their advantages recited, and their applications in a Carnarvon and several Continental mines are shown. The multiple percussion drill is also detailed, and at the end of the book a table showing the relative efficiency of the electric drills in comparison with hand and pneumatic drills is given.

Messrs. Art Fittings, Ltd., who, it will be remembered, recently opened extensive showrooms at 112, Victoria Street, S.W., where artistic metal work and electric light fittings could be seen in rooms decorated in the styles of different periods, have issued a catalogue of designs with a view to showing the nature of the work which is executed by their skilled craftsmen. Section "A" gives some very pleasing English designs of hall and bracket lanterns, electroliers, standards, &c., reproduced from old models made in wrought-iron and finished bright to obtain the effect of old armour, or in dead black, beaten copper, beaten brass, or oxidised silver; Section "B" is devoted to French designs of candelabra and ceiling fittings; Section "C" shows Flemish designs.

Messrs. Laurence, Scott & Co., Ltd., have brought out a number of well set out lists, so bound together as to allow of additions being easily made, in which they illustrate and describe their "Norwich" type four-pole semi-enclosed motors for voltages ranging from 110 to 500 volts. No pains have been spared in the arrangement of data in tabulated form to enable one to see at a glance the code word, B.H.P., speed, price of motor and details, weight and measurements for shipping, list of spares and prices therefor, &c.

The General Electric Co., Ltd., have just issued Section "T" of their catalogue, dealing with traction supplies, "Samsohm" bolts, strains and insulators, the well-known Wood patent section insulators, trolley heads, standards, safety devices, and track cleaners. In their standard hangers and ears the G.E.C. have endeavoured to obtain maximum strength without unnecessary weight of material. They have prepared tables of carbon brushes and gears for motor equipments, and among the other details given in the list are linesman's tools, car heaters, foot gongs, waterproof trolley cord, car lighting and bell accessories, Robertson lamps and their well-known "Traction" telephones. The list makes a good collection of tramway details.

We have received from Messrs. the Simplex Steel Conduit Co., Ltd., a copy of their fifth annual catalogue, which, it will be noticed, has been modified in shape for the greater convenience of users as a pocket-book. The list contains exhaustive information on the well-known wiring system adopted by this firm, and among the many interesting features we may mention their "screw" socket system for obtaining a watertight and mechanically-continuous arrangement, patent spring lids for small-size inspection fittings, dispensing with the previous arrangement of two or more screws, porcelain interiors for use in standard junction boxes, electroliers and brackets, &c. The book also contains copious wiring notes, diagrams and instructions, which will be of considerable utility to contractors using this type of construction.

Messrs. Sanders, Rehders & Co., of 108, Fenchurch Street, E.C., have sent us a neat little book giving full particulars of the Pfluger stationary accumulators, their construction, capacity, weight, &c. The batteries are made by the Pfluger Accumulator Works, Ltd. Full details are given of cells in glass boxes and in lead-lined wooden boxes, prices being stated, and there are comments on mounting, management, &c., with many diagrams and other illustrations.

A circular of "Maxim's" H.V. tumbler switches and other accessories, also incandescent lamps, has been sent in by the Sir Hiram Maxim Electrical and Engineering Co.

Bermondsey Arc Lighting.—Messrs. Crompton & Co., Ltd., who are the contractors for the arc light extensions recently adopted, have accepted the tender of Messrs. Rowland Carr & Co. for the whole of the arc lamp pillars, C.I. switch pillars, and special wall brackets required. The same firm carried out for Messrs. Crompton the sub-contract for the pillars required on the original arc lighting scheme.

Books Received.—"Science Abstracts." February 25th, 1903. London: The Feilden Publishing Co., Ltd. 1s. 6d.

"Technology Quarterly." December, 1902. Boston, U.S.A.: Massachusetts Institute of Technology.

"Conductors for Electrical Distribution; Their Materials and Manufacture," by F. A. C. Perrine. London: Crosby Lockwood and Son. 1903. 20s. net.

"Syndicat Professionnel des Usines d'Electricité: Annuaire 1903." Paris: Siège Social.

"Street's Newspaper Directory for 1903." London: The British, Foreign and Colonial Advertising Offices. 3s. 6d.

"A Lecture on Producer Gas and its Application to Industry," by H. A. Humphrey. London: Commercial Education Department of the London Chamber of Commerce. 6d. net.

Rhyl.—An electrical exhibition was held here last week under the auspices of the U.D.C. Mr. E. H. Wright, the Council's electrical engineer, was mainly responsible for the arrangements, and an interesting collection of exhibits was brought together.

Bankruptcy Proceedings.—The failure of Wm. Peter Durtnall, electrical engineer, &c., 85, Finsbury Pavement, E.C., and Caversham Road, Reading, came before Mr. Justice Wright on Monday in the King's Bench Division, on an application by Mr. E. H. Hawkins, the trustee under the bankruptcy, for an order to be made upon Mr. Percy Mason, the trustee under a deed of assignment, to pay over to the applicant the sum of £166 12s. 9d. received under the deed. The objection of Mr. Mason to pay it over was that he had spent the money upon a contract entered into by the bankrupt with Messrs. Wyman & Co., Ltd., for the installation of the electric light at their Reading factory. After some discussion between the learned counsel, his Lordship made an order for the respondent to hand over £154 13s. 9d. to the applicant, and gave the former leave to carry on the action against Messrs. Wyman in the name of the trustee under the bankruptcy. The consideration of the costs was postponed until the action had been heard, but it was intimated that the bankruptcy trustee's costs could be taken out of the estate.

The creditors of Allan John Lawson, described as of Artillery Mansions, Victoria Street, Westminster, met on Monday at the London Bankruptcy Court before Mr. G. W. Chapman, Official Receiver. It appeared that the receiving order was made on February 25th upon a creditor's petition, the act of bankruptcy cited being non-compliance with the requirements of a bankruptcy notice. The debtor is stated to be the chief executive engineer of the British Electric Traction Co. There was no quorum of creditors present, and the case being one of summary administration, it was left in the hands of the Official Receiver to be wound up in the usual course of bankruptcy. The public examination of the debtor is fixed for April 3rd.

Dissolutions and Liquidations.—In the Chancery Division last Friday, a Mr. Johnson applied for the appointment of a receiver and manager of the Fleetwood and District Electric Light and Power Co., Ltd. Mr. Cann, for the plaintiff, said his client was the registered holder of £6,350 first debenture stock. The company had written to say they could not afford to appear on the motion, but counsel represented the trustees of the debenture deed, and assented to the application, but suggested that the gentleman proposed to be appointed should reside in the locality of Fleetwood. The case was urgent, as interest had been due to the plaintiff since last July, and a creditor of the company would be in a position on the following Wednesday to issue execution. He (Mr. Cann) asked that the gentleman named in the notice of motion, who resided in London, might be appointed at once to save delay. The notice of motion asked for the appointment of a receiver and manager of the company's undertaking, but there might be a difficulty as regarded a manager, because the company carried on a statutory electrical undertaking. Plaintiff was, however, clearly entitled to a receiver. All the facts were proved in the affidavits. No opposition being offered, Mr. Justice Joyce made the usual order for the appointment of a receiver, and gave liberty for the gentleman so appointed to act at once, the plaintiff undertaking to be responsible for his receipts until security was given.

Claims against Messrs. Glen & Co., electrical engineers, Sadler Street, Durham, must be sent forthwith to Messrs. Chambers and Brown, of 40, Sadler Street, Durham.

Notice is given of a first and final dividend of 1s. 11¾d. in the £ in the case of the Meyra Electric Co., of York Road, King's Cross.

The Woolwich District Electric Light Co. is winding up voluntarily.

First meetings of creditors and contributories of the new Imperial Electric Lamp Co. are to be held at Carey Street, W.C., on March 24th.

The statutory meeting of the creditors and shareholders of Hands, Ltd., were held on Wednesday at the London Bankruptcy Buildings before Mr. Winearls, Assistant Receiver. Having dealt with the proofs, the chairman reported that the company was formed in March, 1900, to take over three businesses of gas and electric light fittings manufacturers and merchants, carried on respectively by Mr. A. C. Hands, at Garlick Hill, Hatchet Court and Snow Hill, E.C., by Messrs. W. T. Burbey & Co., at Hatton Garden, and by Mr. Harold Davis, at Stafford Street, Birmingham. The nominal capital was £50,000 divided into 10,000 preference and 40,000 ordinary shares, and the purchase price was fixed at £34,000 in ordinary shares by the vendors, no valuation being made on behalf of the company. Mr. Hands's business was commenced by him in 1892 with a capital of £120, and he had stated that he considered it worth £10,000 when he sold it to the company. He also had an interest in the other two businesses, and estimated the total turnover of the three at about £20,000 per annum, of which between £2,000 and £3,000 was net profit. Accounts had been prepared setting forth the position at the date of the company's formation, from which it appeared that the tangible assets acquired, were of the value of £11,677, so that the goodwill was taken at £22,323. A prospectus inviting subscriptions for 10,000 preference shares was issued in October, 1900, and 1,415 shares were allotted for cash, they being chiefly taken by the directors and their friends. Mr. A. C. Hands acted as managing director at a salary of £1,000 a year, but this was reduced after the first year to £650, and between £500 and £600 was owing to him in respect thereof. On March 23rd, 1900, £10,000 4½ per cent. first mortgage debentures were issued to provide working capital, the Law and Guarantee Trust Society being appointed trustees for the debenture holders. Mr. T. R. Ronald was appointed agent for the trustees in March, 1902, and was through Mr. William Plender (Deloitte, Dever & Co.) now realising the assets. He carried on the business until February 1st last, with a view to Mr. Hands introducing fresh capital to enable the company to pay off the debentures. Mr. Plender had disposed of the Birming-

ham business for £1,500. Mr. Hands attributed the failure of the company solely to the Law Guarantee and Trust Society taking possession under the debentures, and he had asserted that when that step was taken in September, 1902, the assets were more than sufficient to pay all the creditors in full. According to the accounts as at that date prepared, the assets were valued at £12,999, and were subject to debenture claims £10,194, and preference claims £288, which left a balance of £2,517 (subject to realisation) to meet unsecured debts of £6,736. The account with the contributors disclosed a deficiency of £39,999. Mr. E. H. Hawkins (Poppleton and Appleby, chartered accountants, London and Birmingham) and Mr. Archibald Campbell (the principal creditor) were respectively nominated for the post of liquidator, and a vote being taken, the chairman announced that the result would be reported to the Registrar, by whom the appointment would be made in due course.

Trade Announcement.—For the past 37 years the business of Messrs. Askham Bros. & Wilson, Ltd., of Sheffield, has been under the guidance and control of Messrs. John Askham and Phillip U. Askham, but severe illnesses and increasing years have induced them to retire from the active management. Arrangements have, therefore, been entered into for the transfer of the business of Askham Bros. & Wilson, Ltd., to Edgar Allen & Co., of the Imperial Steel Works, Tinsley, Sheffield, as from January 1st last, and Messrs. J. and P. U. Askham will acquire a considerable financial interest in that company. The company's appliances, books of accounts, patterns, &c., together with the services of the managers and other members of the staff, have also been taken over by Edgar Allen & Co., the general management of the business will go on as heretofore, and the long personal experience of Messrs. J. and P. U. Askham will continue to be at the disposal of their successors. For some time past Messrs. Askham Bros. and Wilson had felt that in order to meet the progress of electric tramway construction and the demand for materials therefor increased space, plant and facilities for meeting these demands should be made. Messrs. Askham grappled with the problem, and secured advantageous plots of land with the intention of building as extensive works as other manufacturers in England; circumstances, however, have risen against this, owing to the sudden illness of Mr. Philip U. Askham, the managing director, causing total incapacity from business. Negotiations were entered into with Messrs. Edgar Allen & Co., Ltd., as stated above, and it is believed that not only will the resulting amalgamation be for the benefit of the two firms, but also for tramway engineers and corporations generally. Mr. Fred Bland, who for many years has been well known in tramway circles, remains with the new firm as director of the tramway department, and as the entire staff has been taken over, there will be no break in the continuity of the business. During the 37 years that Messrs. Askham have carried on their business they have seen very great changes in the trade. Commencing as steel manufacturers in 1866, they gradually increased their business, adding first one article and then another, in the shape of tools, then crucible steel castings, and then tramway points and crossings. They were the first makers of crucible steel points and crossings, for which, however, there was no great demand for horse tramways, but when steam was introduced the demand was increased considerably. When they invented a patent automatic spring point, rendered compulsory by the Board of Trade, rapid extensions were made in the business, but when electric traction became the order of the day, even this extension was doubled. In addition to the tramway business, what was practically a separate department was carried on for the manufacture of crushing, grinding and separating machinery, also elevators and conveyors.

Linolite.—The Library of the Royal Institution will be illuminated by about 40 ft. of Linolite on the occasion of this evening's lecture.

Catalogues Wanted for Abroad.—The secretary of the Institution of Engineers of the River Plate, Mr. Ernest Danvers, whose address is Calle 475 B. Mitre, Buenos Aires, will be glad to receive catalogues from British manufacturers and others for placing in the library of that Institution. We have no doubt that every manufacturing department before whose notice this announcement comes will readily respond to the invitation with a view to future business.

Directory.—We have received a copy of the 38th edition of the *Export Merchant Shippers' Directory* from Messrs. Dean & Son, Ltd., of 160A, Fleet Street, E.C. (15s. 6d.). It is a book which is calculated to be of considerable use in mercantile circles. Its main contents are alphabetical lists of merchants in different parts of the country, together with particulars of their trading ports, and the class of goods they ship. There are also other matters of interest to commercial men.

Tampering with Slot Meters.—At Manchester on February 11th, Henry Peters was charged with fraudulently abstracting and using electricity belonging to the Trafford Park Dwellings Co., Ltd. The prosecutors supply their tenants with electricity by means of slot meters, and defendant was one of their tenants. He placed a piece of wire in the coin box, and a test showed that current to the value of 9s. 6d. had been used, whereas only 2s. 7d. was found in the meter. A fine of 20s. and costs was imposed. Elizabeth Morris, for a similar offence, was fined 10s. and costs.

ELECTRIC LIGHT AND POWER NOTES.

Abingdon.—The T.C. has instructed Mr. H. W. Wilkinson, of Westminster, to prepare a report on the possibility of establishing electricity works there.

Arbroath.—The T.C. is writing to the Angus Electric Light Co. to ascertain on what terms they will carry out an electrical installation in Arbroath, before deciding to carry out its provisional order.

Bath.—The Town Council on Tuesday last decided:—(1) To definitely adopt the policy of a gradual change over the central area of the city to the continuous current system; (2) not to spend any money upon works of a temporary nature. The E.L. Committee is to be authorised to spend the sum of £25,000 during the current year and £12,906 in the following year to complete the essential portion of the scheme. The engineers assure the Committee that in this way the whole scheme can be satisfactorily carried out.

Batley.—The T.C. has decided to charge for electricity on Wright's maximum demand system at 6d. per B.T. unit for the first hour and 3d. after, with 3d. and 1d. per unit for power purposes, and a discount of 2½ per cent. for cash.

Bournemouth.—The local electricity supply company has reduced the price of energy for lighting to 6d. per unit, and for heating and power purposes to 3d.

Brighton.—Owing to the continued objection of the U.D.C.'s of Portslade-by-Sea, Southwick and Shoreham to the terms of the Brighton Corporation Electrical Bill, it has been decided to leave out those districts.

Bristol.—The T.C. has received from the L.G.B. sanction to borrow £73,550 for extensions in connection with the electricity department.

To meet the rapid increase in the demand for continuous current for power purposes in Bristol, there has just been fixed at the Temple Back station a turbo-dynamo of 500 KW, and trial runs have been made this week. The turbine was supplied by Messrs. C. A. Parsons & Co., and the dynamo by Messrs. Siemens Bros. & Co., the combination running at 2,500 revolutions a minute. The new turbo-generator takes the place of three smaller engines and dynamos, and three others are to be removed to make way for another 500-KW. unit. The station is crowded with plant, and by the substitution of these two turbo-dynamos an increased power of over 400 KW. will be obtained. The new turbo-generators are of the 500-volt, 1,000-ampere type. Two turbo-alternators, each of 750 KW. normal, or 920 KW. emergency power, have been ordered for the new section of the Avonbank works, now in course of erection.

Broughty Ferry.—The question of erecting a number of additional arc lamps is being considered by the T.C.

Burslem.—The T.C. has decided to extend the area for the supply of electricity to Wolstanton and other outlying districts.

Mr. W. H. Trentham has been engaged as expert to report to the Council as to the advisability of accepting or rejecting the terms offered by the Potteries Electric Traction Co. for a supply of electricity to the town.

Carlisle.—Last week a L.G.B. inquiry was held into an application of the Corporation for sanction to borrow £24,000 for the purposes of the electricity undertaking. The sum was made up as follows:—£2,089, the amount by which the original expenditure on the works had exceeded the sum of £30,000, which the Council received power to borrow; £16,098, the cost of plant to enable the Corporation to supply the Tramway Co. with power; and the balance for other new works carried out. Mr. Burnet, the electrical engineer, and Mr. Marks, the city surveyor, gave evidence. There was no opposition.

Chippenham.—The T.C. is considering the advisability of establishing a municipal electric light works.

Dorchester.—As the result of a canvass by the Council, out of 152 calls, 78 consumers, representing 2,511 lamps, have been booked, and only 16 absolutely refused to take the light. There are also five applications for energy for motive power.

Dublin.—A special meeting of the T.C. has been held for the purpose of considering a report of the Lighting Committee recommending that the consulting engineer, Mr. Robert Hammond, be authorised to arrange for the carrying-out of the alteration of Fleet Street station for distributing purposes under the new scheme, at a cost of £993. The report was adopted.

Dumbarton.—The scheme for the electric lighting of the burgh, submitted by Messrs. Crompton & Co., of London, has been accepted. In the offer, Messrs. Crompton hold themselves bound to commence supplying electricity within 12 months, and to complete the installation within 18 months. They undertake to pay the sum of £300 as a contribution towards the cost of the prov. order, and a further sum of £100 per annum during the first seven years; £200 during the following seven years; and £300 thereafter. The maximum charges are to be 6½d. per B. of T. unit, and 2½d. per unit for power purposes and public lighting. The Council

can terminate the agreement on purchasing the undertaking as a going concern at fixed periods. Messrs. Crompton are bound to promote a provisional order for tramways in the district with extensions to the Vale of Leven.

Eton.—The Maidenhead Electric Lighting Co. have intimated to the R.D.C. that they intend to apply for a prov. order empowering them to supply a portion of the Council's area.

Edinburgh.—The E.L. Committee has recommended the T.C. that the commission payable to Prof. Kennedy should be fixed at 4 per cent. on all new machinery for the electric lighting stations and other works of a new description, as from May 15th last, but that on general extensions of mains, &c., following on old lines, he be paid no commission. The recommendation was agreed to.

Falkirk.—The applications received up to date represent 4,000 8-c.p. lamps. It was estimated that the applications at the end of the first year would reach something like 6,000 8-c.p. lamps, and the supply was only commenced on the 3rd inst.

Glasgow.—In order to utilise the surplus generating plant in the power station of the tramway department, the electric lighting department agreed some time ago to buy from it a minimum of 150,000 units per annum at the rate of 1½d. per unit. The E.L. Committee has now agreed to take a further 200,000 units on the same terms, making 350,000 units in all. By this arrangement the extension of the electric lighting plant is delayed, while it permits the tramways department to utilise to the full extent its generating plant.

Gravesend.—The assessment of the electric lighting works has been reduced on appeal from £1,100 gross, and £990 net, to £450 and £337 respectively.

Hove.—The T.C. has decided that it is inadvisable for permission to be given to the electric lighting company to lay a main in the parish of Aldrington.

Kent.—A conference has been held at the B. of T. offices of parties interested in the application of the County of Kent Electrical Power Distribution Co. for the consent of the local Councils to their application for a prov. order to be dispensed with.

Lichfield.—The T.C. has applied for the electric lighting area to be extended so as to include Whittington Barracks, Trent Valley Station and other places.

London.—The Charing Cross and Strand Electricity Supply Corporation was summoned at Bow Street Police Court on 5th inst. for doing certain work without giving notice of intention to the local authority. The proceedings were instituted by the Westminster City Council. The defendant corporation carried on operations under an electric lighting order. There were certain restrictions to its powers, especially with respect to the taking-up of public roads. For instance, the corporation was required, except in cases of emergency, to give 28 days' notice to the local authority before undertaking works in the street, unless they were repairs, renewals, or amendments of existing works. Without giving any notice to the local authority the defendant corporation made an excavation at the corner of Garrick Street and St. Martin's Lane, for the purpose of putting down a large distributing chamber in place of the existing one. After the work had been commenced, the defendant corporation sent the Council an emergency notice; but there was no emergency. The work was in progress about a fortnight, and during that time there could, in consequence of the obstruction, be only one line of traffic. Evidence having been given for the Council, Mr. William Henry Patchell, chief engineer to the corporation, was called for the defence. He stated that one of the persons supplied by the corporation complained of insufficient pressure, and the distributing box at the corner of Garrick Street and St. Martin's Lane was examined. It contained 12 cables, but only three of them were "alive." It was decided to "liven" the dead ones, but it would have been dangerous to do so without putting in a larger box. Mr. Lane, for the defence, submitted that no offence had been committed, as the work done was a work of emergency. It was, he contended, not a new work, but a renewal or amendment of an old one, and 28 days' notice was not necessary. Mr. Marsham said he did not agree with that, and fined the defendant corporation 20s. and £2 2s. costs. The magistrate expressed his willingness to state a case.

Bermondsey.—At Tuesday's meeting of the Borough Council, the district auditor, in his report for the 12 months ending March 31st, 1902, said:—"At or about the close of the year upon which I am now reporting, the Council engaged in the work of wiring and fitting the premises of private consumers. It does not appear that the statutes of the order relating to Bermondsey authorise the Council to enter into competition with the trading firms who are engaged in this work, or that the rate funds can lawfully be expended upon the purchase of material, or upon labour for this purpose. This interpretation of the law agrees with that of the L.G.B. and of the B. of T., who hold that the local authority is not authorised to go beyond the consumers' terminals, except for the supply and fitting of meters." The matter was referred by the Council to the E.L. Committee, and it was resolved in the meantime that no fresh contracts for wiring consumers' premises be entered into.

Westminster.—At the City Council meeting the General Purposes Committee reported that the Westminster Electric Supply Corporation's charge for electrical energy is at the rate of 6d. per unit for the first 4,000 units, proportionately divided between the various departments of the city according to consumption, and thereafter at the rate of 4d. per unit for the remainder, whereas St. Martin's Lane Library is supplied by the London Electric Supply Corporation at the all-round charge of 4d. per unit. The Committee was of opinion that the first-named corporation should be asked to reduce its charges to the same rate, subject to the existing rebate of 8 per cent. for the 200-volt supply. It was resolved to send a communication to the Westminster Electric Supply Corporation on the matter.

Battersea.—The Borough Council has resolved to provide, at an estimated cost of £472, hoisting and lowering gear for the additional arc lamps to be put up.

Hammersmith.—It has been resolved to obtain the necessary sanction to increase the capacity of the Brook Green sub-station from 75 to 150 kw. at an estimated cost of £214. The extension of the pipework connected with the condensing scheme, to the bed of the river, is to be carried out at a cost of £1,450.

Owing to breakdowns having occurred in the arc lighting arrangements of the borough, a report has been obtained from Sir W. H. Preece, advising that in future continuous current arcs in series should be adopted and new cables laid in place of the existing ones.

Poplar.—The Borough Council has decided on asking the L.C.C. to insert a clause in the next General Powers Bill to prevent the possibility of electric current being carried by means of overhead wires to consumers within a borough from an outside supply. It is believed that this is quite possible at present, for, although local authorities control the opening of their roads for laying cables, no restriction can be placed upon the use of overhead wires.

L.C.C.—The arbitration proceedings between the Metropolitan Electric Supply Corporation and the London County Council were resumed last week, and again adjourned. The case for the company was closed a few weeks ago. Mr. J. Fletcher Moulton, K.C., for the Council, stated that since the last adjournment his clients had prepared fresh plans of the new generating station, and these were put in. Mr. Manville expressed the opinion that an efficient generating station of 4,000 kw. could be constructed for about £151,000, and the works could be completed within the two years allowed by the Act under which the Council acquired the property.

Lowestoft.—The Committee has resolved to add further balancing plant for tramways and other purposes at a cost of about £800, and that Mr. Hawtayne be instructed to obtain tenders.

Ludlow.—The D.C. having received a letter from the B. of T. stating that they refused to extend the time of the prov. order for electric lighting, has resolved to at once put in force its powers.

Luton.—The Committee has considered the question of the supply of energy for tramway purposes, and has instructed the electrical engineer to prepare and submit a report as to the amount which the present plant could produce to work eight or 10 cars on a 10 minutes' service, particulars as to its cost of production, &c., and if the present plant could not be utilised, the cost of providing and fixing new plant, &c.; the report was to be ready for submission by Tuesday, March 17th, to a joint meeting of the Electric and Tramways Committee.

Lyndhurst (New Forest).—An appeal has been made to the B. of T. on behalf of the undertakers under the Lyndhurst E.L. order, 1901. It was stated that if the department would defer their decision as to the revocation of the order for a short time, there was every possibility of the capital being raised for carrying out the order in its entirety and also the powers of the light railway order. The Board, in assenting to the application, intimated that if at the expiration of the three weeks asked for, the undertakers had not made the deposit required by Section 8 of the order, the Board would proceed to revoke the order without further notice.

Middleton.—It appears that some inexplicable error occurred in our reference to this town last week. Mr. S. Pauls, borough electrical engineer, reminds us that the Corporation already possesses an electric light and traction station.

Musselburgh.—Negotiations for the transfer of the electric lighting and tramways scheme having been completed with the National Electric Wiring Co., London, it is expected that work in connection with the undertaking will be begun within a few months.

Paisley.—The T.C. has had under consideration a report on the minimum capital outlay for the extension of the present plant to meet the load for the coming winter, based on the assumption that the maximum load at the end of the year would not exceed 700 kw. The report showed that the expenditure required under an alternating current scheme would be £34,294 5s., and under a continuous-current scheme £41,476 10s. A second report showed the expenditure which would be necessary this year for lighting only, and stated that, provided power was not required for more than 20 cars during the current year, it would not be necessary to obtain further borrowing powers. The Council subsequently agreed to obtain tenders for supplying a 300-kw. engine and alternator, and for the extension of the existing buildings and cables.

Pollokshaws.—The T.C. has instructed the Streets Committee to bring up a report on the question of lighting the burgh by electricity.

Pretoria.—The report of the consulting engineers, Messrs. Mordey & Dawbarn, states that the estimated cost of the proposed electric lighting scheme is £150,000, which sum will include the purchase of a portion of the plant of the electric lighting company. The experts also estimate that the carrying out of their

scheme will enable the Council to sell energy for lighting purposes at 6d. to 8d. per unit, and for power purposes at 3d. to 4d. per unit. The present cost of energy for private lighting is 1s. 9d. per unit, and for street lighting 11d. per unit.

Pwllheli (Carnarvonshire).—The Gas Co.'s directors have expressed their readiness to take over the electric lighting provisional order granted in 1900; the Corporation to be reimbursed the cost of obtaining the order, and the company to supply public lighting at 4d. per unit, private lighting at 6d., and power at 2½d.

Ramsgate.—As the electric lighting order obtained by the T.C. expires this year, inquiries are being made with a view to leasing it to the Isle of Thanet Electric Tramway Co. or some other syndicate.

Reigate.—There was no opposition at the L.G.B. inquiry into the application of the T.C. for a loan of £3,500 for E.L. purposes.

St. Helens.—At the last meeting of the T.C. the subject of abandoning steam for other power at the Brown Edge Waterworks was considered. Mr. Lackland, engineer, stated that if electric motors were installed the total cost would be £275 15s. A gas engine installation would cost £238 10s., showing a difference of £37 in favour of gas. The Council decided to obtain an electric motor, owing to want of floor space.

Slough.—The B. of T. will allow the R.D.C. to purchase only so much of the Slough and Datchet electric supply undertaking as is in their district, the Eton Rural District Council being thus empowered to acquire the Datchet portion in 42 years' time.

Surbiton.—The U.D.C. has decided to enter into an agreement with Messrs. Callender & Co. for the free wiring of consumers' premises.

Swanscombe.—The Parish Council has resolved to support the application of the Kent Electric Power Syndicate for a prov. order authorising it to supply electricity.

Twickenham.—Edmundson's Electricity Corporation has called the attention of the U.D.C. to the powers sought by the London United Tramway Co. to supply electricity in the Council's district. Such powers would seriously injure the prov. order which the Council has the power to purchase. The Council has decided to petition against the Bill.

Wilmslow.—The B. of T. has revoked the electric lighting order of 1897. The ratepayers had opposed a scheme prepared by the Council, and as a result it was dropped. It is now decided to oppose the Bill of the Electric Power Co.

Yarmouth.—The T.C. has received sanction to borrow £16,500 for extensions.

In consequence of complaints as to the alleged inaccuracy of charges for energy, the T.C. has decided to give consumers the option of having their meters tested free of charge, if errors of more than 2 per cent. occur.

ELECTRIC TRACTION NOTES.

Barnsley.—The T.C. in committee has recommended to the Corporation that the electrical engineer shall be allowed to accept the post of supervising engineer to the Tramways Co.

Beckenham.—The B.E.T. Co. has asked whether the U.D.C. is prepared to supply energy for working the trams at Penge, and at what price. The Council has referred the matter to the E.L. Committee. The Council will on April 2nd consider an application from the company for its consent to the promotion of a Bill for the construction of a tramway from Beckenham Village to Bromley.

Birmingham.—The Tramways Committee has been informed by Mr. Garcke that the tramways company cannot possibly increase the terms of their offer, though they were working out a proposal on the basis of the immediate electrification of the tramways now worked by steam and horse, but not providing for any extension of the leases beyond June 30th, 1911.

Brighton to Littlehampton.—The B.E.T. Co.'s Bill for the South Coast Tramways has been allowed to proceed on condition that the projected lines through Littlehampton and Worthing, and also a large part of the tramways in Hove, are withdrawn from the Bill unless consent of the various road authorities can be proved to have been obtained before a Committee of the House of Lords. In neither case has this consent been obtained, and consequently the lines will have to be withdrawn. The powers to reconstruct the Shoreham Tramways will be retained in the Bill, and also a clause seeking for running powers over the system of the Brighton Corporation. The latter are not likely to be obtained.

Cardiff.—The tramway accounts estimated to the end of March are reported to show a revenue sufficient to enable the committee to repay the £9,299 obtained during the year towards loan charges. Mr. Ellis stated that the receipts for the year would be about £80,000.

Egypt.—The *Egyptian Gazette* of recent date notifies the arrival at Alexandria from Manchester of the ss. *Persian Prince*, bringing eight cars for the new electric installation on the Ramleh Railway. The same journal denies the truth of the story that the Ramleh Railway Co. had asked the Egyptian Railway Administration for a concession to make an electric tramway on the Aboukir line.

Exeter.—The poll respecting the Council's tram scheme has resulted in 7,581 votes for the Bill and 3,595 against—majority 3,986. A mandamus and a fresh poll were applied for by Mr. Ross on the day of the count on the ground that pro-tram literature had been distributed in such a way as to lead people to think that it came from official sources. The Lord Chief Justice and Mr. Justice Channell refused the application, but the matter will probably be made the subject of further contest "in another place." The main fight over the Bill will now take place before the House of Lords Committee. The opposition emanates chiefly from a number of traders in the High Street, who fear injury to their businesses if the trams run through the principal thoroughfares. Meanwhile the Council is in negotiation for the purchase of the present small horse-tram system.

Gateshead.—The company's electric tramcar service was brought almost to a standstill on 13th inst. by a strike of conductors and motormen.

Ilford.—Last Saturday the Council's electric tramway system was publicly opened. Energy is taken from the lighting station, of which some particulars appeared in the Electrical Review for June 7th, 1901. Two main lines run from the Broadway, one running to Barking Side and the other to Chadwell Heath. A ½d. service was to commence on Monday.

Leith.—Mr. James More is about to make an inspection of the stock and plant of the Edinburgh Street Tramways Co., from which he will submit a valuation to the Leith Corporation. He will report whether the undertaking could be made a paying concern if taken over by the town, and will give an opinion on the subject of electric traction with energy supplied at 1½d. per unit.

London.—The Prince of Wales is going to open the L.C.C. electric tramways on Friday, May 15th. At Tuesday's meeting of the Council it was stated by Mr. Benn that 160 of the Council's horse drivers had passed the motor-car driving tests, only four having failed. The teacher at the motor-car school said that he had never had better material to work upon.

The new extension of the London United Tramway Co.'s electric system from Twickenham to Hampton Court and Kingston Bridge is now completed, and a trial run was made on 16th inst.

L.C.C.—The Highways Committee proposes the following weekly rates of wages for employés in connection with the electric tramways:—Charge engineer at the temporary power station £3 10s. to £4 10s., and shift engineer £3 to £3 10s.; charge engineer at the substations, £2 10s. to £3; and switchboard attendants, £1 10s. to £2. Of the mains and conduit men, foremen jointers are to receive from £2 10s to £3; superintendents from £2 10s. to £3; and special-work fitters, £1 15s. to £2; whilst the pay of greasers and cleaners is to range from £1 10s. to £1 15s. per week.

Camberwell.—A notice has been received by the M.B.C. from the electrical engineer of the L.C.C. giving notice of intention to proceed with the work of electrification of the tramways in the borough.

Manchester.—A scheme is on foot for a 10-mile system of electric cars without rails in this vicinity. It is intended that the south-eastern section of the Manchester Suburban Electric Tramways scheme of 1901—from Barton Bridge to Glossop, Hyde and Stalybridge—shall be worked in this way if financial arrangements can be carried through. The trackless trolley system, as frequently described and mentioned in these columns, is to be adopted. Mr. John M. Newton, of 27, Victoria Buildings, Manchester, is engineer for the scheme, in conjunction with Mr. J. W. Welch, A.M.I.C.E. The application for powers will come forward in a month or two.

Perth.—The T.C. is going to take over the system of the Perth Tramways Co. for £21,800.

Sunderland.—The extension line which runs to Fulwell has just been completed, and it awaits inspection by the Board of Trade. The line is partly single and partly double. The work of construction has been carried out by Messrs. Dick, Kerr & Co.

TELEGRAPH AND TELEPHONE NOTES.

French Cables.—M. Trouillot, Minister of Posts and Telegraphs, last week submitted to the Paris Chamber a measure providing for the inclusion in the budget for 35 years of a credit for completing the system of cables to the French colonies. The Government has also negotiated with Great Britain for the right

landing the cable from the island of Réunion at Mauritius. It has further entered into negotiations with Holland for the laying of a cable between Saigon and Pontianak, in Borneo.

Portsmouth Telephones.—It has been reported to the Telephone Committee of the T.C. that since January 86 applications have been received, bringing the total up to 1,033 for Portsmouth; there are also 310 subscribers in the country districts. It has been found necessary to alter the central exchange switch-table in the Town Hall, and 70 extra places are to be added, which will complete the 1,000-line switchboard. The switchboard, also, will require extending, and quotations are to be asked for doing the work.

The P.O. Telephones in London.—The official returns relating to the first complete year's working of the postal telephone system in London shows that the number of subscribers has far exceeded the highest official anticipations, and the installation *is said* to meet with the general approval of users. Seven exchanges have been opened—one (the Central) at the premises in Queen Victoria Street, E.C., formerly occupied by the Post Office Savings Bank, and others known respectively as the Victoria, Western, Putney, Kingston, Richmond, and Wimbledon. At the Central depôt, no fewer than 6,110 exchange stations were in operation at the end of the first year, which closed on the 28th of last month The number of such stations in connection with the other centres enumerated was as follows:—Victoria, 564; Western, 570; Putney, 222; Kingston, 216; Richmond, 152; and Wimbledon, 140. Active work is proceeding at the Mayfair exchange, which it is hoped to open in about eight months. An exchange at Hampstead is in course of construction, and will probably be opened in the autumn. The work in connection with an exchange at Chiswick is being pushed forward, and it is expected to be in working order within the next two or three months. At Croydon it is anticipated that an exchange will be opened about three months hence. In addition to the above exchanges, preliminary works have been begun at Epsom, Sutton, Ealing, and Crouch End.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1900	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
St. Lucia-St. Vincent	Nov. 18, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiros	Aug. 13, 1902	
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902	
St. Jacques-Haiiphong	Jan. 3, 1903	
Jamaica-Colon	Dec. 31, 1902	
Paramaribo-Cayenne	Feb. 23, 1903	
Trinidad-Demerara No. 2	Feb. 27, 1903	
Zanzibar-Mombassa	March 7, 1903	
Myitta-Kanburi	March 16, 1903	
Landlines:—		
Route to Tientsin and Taku *via* Helampo	June 18, 1900	
Communication with Honduras-Central America	Feb. 26, 1903	
Indo-European lines between Odessa-Kertsch	March 12, 1903	March 18

Wireless Telegraphy.—The *Morning Advertiser*, or, to put it very precisely, "Vindex," writing an article in the columns of that newspaper, has laid a challenge before Mr. Marconi in quite unmistakeable language. The article appeared on Friday last. After referring to the doubt which exists in some scientific and other circles as to whether wireless messages really have been sent across the Atlantic, "Vindex" challenges Mr. Marconi to set at rest the rumours that are rife, and lays down the following conditions:—

"(*a*) Will he, within 14 days, send a message from any of his American stations to Poldhu, Cornwall?

"(*b*) Will he agree to send that message at a fixed time, viz., 12 noon, American time?

"(*c*) Will he agree that the message handed to the American operator shall be unknown except to the person handing it in?

"(*d*) Will he permit the following jury of disinterested and prominent Americans to frame the message to be sent, limited to five words, viz.:—

"1. The editor of the *New York Herald*.

"2. Mr. Hearst, of the *New York Journal*.

"3. The editors of the *New York World* and *Sun*.

"(*e*) Will he select from the editors of London four gentlemen disinterested to arrange for the reception of the message sent?"

The article continues:—"That surely is a fair test. It is less than Mr. Marconi claims to have done. His success will be heralded the world over, and placed beyond all doubt by his acceptance of the challenge."

We turn to the *St. James's Gazette* for the same day and find what is reported to be an account of an interview with Marconi on the subject. This is the way he receives the challenge:—

"I cannot accept these conditions. It would be an insult to the Governments which have taken up the matter, and particularly to the Italian Government. Then there is the Canadian Government, which set apart a large sum in connection with a service between Canada and England."

"Then you unhesitatingly reaffirm your claim that messages have passed?—Most certainly I do. Let them ask Lord Kelvin. His lordship, I think, will be able to satisfy them.

May I ask, Mr. Marconi, whether you are prepared to give a public demonstration to prove the claim?—I am prepared to demonstrate it to any responsible tribunal, but I am not prepared to accept a newspaper challenge."

Mr. Marconi is hyper-sensitive in his attitude toward the Governments which have accorded him their valuable patronage, but their support is very weakly founded if experimental proofs given to some unbelievers are to be regarded as insulting to generous nations. Mr. Marconi thinks that what is good enough for King Edward ought to satisfy his subjects. We accept that statement with certain reservations which it is unnecessary to state in detail.

A good deal has been said lately as to an alleged refusal of the Post Office authorities to give the Wireless Telegraph Co. the same facilities as are extended to the cable companies, in order to enable telegrams to be sent right through for transmission by the ether. A correspondent who is in close touch with the officials of the Post Office informs the *Pall Mall Gazette* that these statements are quite misleading. "The Wireless Telegraph Co. has never even asked for a licence such as is granted to the cable companies; and as for the alleged refusal to connect the Poldhu signalling station to the nearest post office at Morrow, a private wire could have been had months ago on the usual terms, had it been applied for. What the Wireless Telegraph Co. has been demanding is an "exclusive licence," such as no cable company enjoys, and the effect of which, if granted, would be to prevent the Government from granting a similar licence to any competing system, even to such as were in existence before the Marconi Co. began operations."

We cannot refer to all that is being said in the newspapers respecting the Marconi controversy, but we would say that Mr. Cuthbert Hall, of the Marconi Co, has written to the *Pall Mall* at some length contradicting the above statement. In regard to rival methods, Mr. Hall says that he knows of no "commercial wireless telegraph circuit of any system" except the Marconi, which has "the apparatus available for sending the messages of the public at a charge per word or per message." In regard to interception of messages, as the *St. James's Gazette* of 18th inst. points out, the Eastern Telegraph Co. has received Marconi messages at Land's End. The Post Office station at Holyhead has also received them without any attempt at tapping.

Mr. Marconi was entertained to dinner by the Italian Colony in London at the Prince's Restaurant last week.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—March 20th. Overhead equipment, poles, feeder cables, &c. See "Official Notices" February 13th.

Barrow-in-Furness.—March 25th. Cable and conduits. See "Official Notices" March 13th.

Bedford.—March 23rd. High and low-pressure cables. See "Official Notices" March 13th.

Belfast.—April 10th. Water-tube boiler with superheater and mechanical stoker and superheater for Lancashire boiler. See "Official Notices" to-day.

Belgium.—April 11th. Tenders for the Municipal Authorities of Liège, for the installation of a complete electric lighting plant at the Theatre Royal, Liège. Tenders to L'Annexe de l'Hotel de Ville, Liège, whence full particulars may be obtained for 30 francs.

Blackburn.—March 23rd. Stores, incandescent lamps, meters, cables, arc lamp carbons, joint-boxes, switches, fittings, &c., for 12 months. See "Official Notices" March 6th.

Bristol.—April 8th. Pumps, exciters, motors, pipework, coal conveyor and lamp standards. See "Official Notices" to-day.

Brussels.—March 25th. At the Brussels Bourse for account of Belgian State Railway: supply of sundry objects for the use of the electric installations department, in eight lots. Particulars from the offices, 76, Rue Belliard, Brussels.

Burgess Hill.—March 27th. Complete electric light installation. See "Official Notices" to-day.

Bury.—March 30th. The Electricity Committee invites tenders for the following plant:—Section C, boilers and other ironwork; Section D, superheaters; Section E, economisers.

Denmark.—March 31st. Copenhagen Public Lighting Department wants tenders for the supply of five water-tube boilers of 300 sq. metres heating surface capacity each. Particulars from the Copenhagen Belysningsvaesen, Vestre Boulevard, Copenhagen.

Edinburgh.—April 6th and 13th. Carbons and pavement and road-box frames and covers, &c. See "Official Notices" to-day.

Finchley.—April 11th. Piping, switchboard, boosters, &c. See "Official Notices" to-day.

France.—March 27th. French Post and Telegraph Authorities in Paris; 10 tons of galvanised iron wire, 1 mm. diameter; 70 tons ditto, 4 mm. diameter; 190 tons ditto, 3 mm. diameter; and 12 kilometres of submarine cable core. Particulars from Le Sous-Secretariat d'Etat des Postes et Telegraphes, 103, Rue de Grenelle, Paris.

France.—March 27th. French Post and Telegraph Authorities in Paris; 12 kilometres of submarine cable core, 70 tons of galvanised iron wire, 4 mm. diameter, 190 tons ditto, 3 mm. diameter, and 10 tons 1 mm. diameter. Particulars from Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—April 1st. Municipal Authorities of Paris; installation of a group of boosters at the Halles municipal central power station. Particulars from L'Hotel de Ville, Paris.

Fulham.—March 30th. Mains for electric lighting. See "Official Notices" March 13th.

Gillingham.—March 30th. 500 tons coal, oil, and electricity meters. See "Official Notices" March 13th.

Ilford.—March 24th. Electricity meters, fuse boxes, incandescent lamps, cables, stores, &c. See "Official Notices" March 13th.

L.C.C.—March 24th. Traction switchboards to be erected at Deptford. See "Official Notices" February 27th.

Leek.—April 3rd. Two gas engines, two 60-KW. dynamos, cooling tanks, pipes, &c.; stoneware casings, cable work, &c. See "Official Notices" March 13th.

Londonderry.—April 24th. Lancashire boilers, pipework, pumps, &c., steam dynamos, boosters, battery, switchboard, crane, conduits, cables, &c. See "Official Notices" March 13th.

Lowestoft.—April 8th. Dry-back boiler and superheater, pump and accessories; piping, &c.; condenser, pumps and cooling tower; 500-KW. steam dynamo, &c.; switchboard. See "Official Notices" March 13th.

Madrid.—March 23rd. At the Postal and Telegraph Department, Madrid; supply of 40,000 insulators in porcelain. Estimate 40,000 pesetas.

Manchester.—Electric lighting and organ-blowing arrangements at All Saints' Church, C.-on-M. See "Official Notices" to-day.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

Rotherham.—March 24th. 15 double-deck cars. See "Official Notices" March 13th.

Sheffield.—March 23rd. 100 car wheels and 400 steel tires. See "Official Notices" March 13th.

Spain.—March 23rd. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until the 23rd inst. for the supply of 40,000 porcelain insulators. Particulars may be obtained from, and tenders are to be sent to, La Direccion Général de Correos y Telegrafos, Carretas, 10, Madrid.

St. Pancras.—March 24th. 47 miles lead-covered and armoured cable. See "Official Notices" March 6th.

Stretford.—March 27th. Switchboards, &c.; battery, booster, &c.; motor-generators; meters. See "Official Notices" March 13th.

[Will our readers note that in our "Official Notices" last week the date for sending in tenders was wrongly printed. The 27th inst. is correct.]

Sunderland.—March 27th. Annual supply of I.R. covered cables and stoneware casings; one fuel economiser. See "Official Notices" February 27th.

Sunderland.—March 27th. Two Lancashire boilers. See "Official Notices" March 6th.

Swindon.—March 24th. Switches, incandescent lamps, boxes, &c., for adapting 90 street lamp columns for electric lighting. See "Official Notices" March 6th.

Walthamstow.—April 4th. Free wiring. See "Official Notices" March 13th.

Wednesbury.—March 28th. Motor-generators, boosters, accumulators, switchboards, cables, &c., and street work, meters, indicators, fuses, &c. See "Official Notices" February 27th.

Wimbledon.—April 6th. 500-KW. steam alternator, water-tube boiler, economiser, feed pump and pipework, and one steel or brick chimney shaft. See "Official Notices" to-day.

Wrexham.—March 21st. Stores, cables, joint-boxes, &c., meters, incandescent lamps, carbons, &c. See "Official Notices" March 6th.

CLOSED.

Ashton-under-Lyne.—The T.C. on March 10th accepted the tender of Mr. J. Spencer, of Wednesbury, for the supply of poles for the electric tramways.

Blackburn.—Messrs. Yates & Thom have placed an order with Messrs. Veritys, Ltd., for a large power switchboard for their works, including patent "VS" circuit breakers.

Brighton.—From the various tenders received for the brickwork and buildings of the new electricity works at Southwick, that of Messrs. W. A. Field & Co., of Brighton, is recommended for acceptance at £20,300.

Brighton.—The T.C. has received the following tenders for the feeder and telephone cables for the Old Steine and London Road extensions:—

Western Electric Co.	£994
Callender's Cable Co.	1,099
St. Helens Cable Co.	1,167
Henley's Telegraph Co.	1,182
F. W. Dennis & Co.	1,260
Siemens Bros.	1,267
W. T. Glover & Co.	1,339
Johnson & Phillips	1,540
The Electrical Co.	1,619

The Committee recommend the Council to accept the lowest, viz, that of the Western Electric Co.

Bristol.—The Electricity Committee has accepted the tender of Messrs. Ferranti, Ltd., for the supply of switchgear, and that of Messrs. Alley & Maclellan for condensing plant.

Bolton.—The Corporation Electricity Committee has accepted the tender of Messrs. Musgrave & Son, for alterations to the main range of steam pipes at the electricity works.

Glasgow.—Messrs. Pearce & Co. have placed the subcontract for an engine and generator for the Ruchill destructor with Messrs. James Howden & Co.

Grimsby.—The T.C. has accepted the tender of Mr. A. C. Dickins, of Grimsby, for an electric light installation at the Higher Grade School at £227. 10 tenders were received.

Hackney.—The Lighting Committee has recommended that the tender of the British Westinghouse Co. at £9,546 for generating plant be accepted, and that of Messrs. Ashton, Frost and Co. for condensing plant at £2,199.

Hebden Bridge.—The U.D.C. has accepted the following tenders in connection with the electric lighting scheme:—Campbell Gas Engine Co., for gas engines for direct coupling to dynamos; Messrs. Greenwood & Batley, for dynamos, booster and balancer; Tudor Accumulator Co., Ltd, for storage battery; Messrs. Hodgson, Wright & Wood, for switchboard.

Leith.—The Corporation has placed with Messrs. Crompton & Co., Ltd., an order for two 350-KW. multipolar dynamos, to be coupled to Howden triple-expansion engines.

London.—The following tenders have been received by the London County Council for the supply of a battery for the meter testing station in Cranbourne Street:—

Prichetts & Gold	£242	0	0
Hart Accumulator Co.	307	9	0
Electrical Power Storage Co. (accepted) ..	307	14	0
Tudor Accumulator Co.	372	0	0
D.P. Battery Co.	439	0	0
Chloride Electrical Storage Co.	513	0	0

Lowestoft.—The following are the tenders accepted by the T.C. in connection with the electric tramways:—Messrs. A. Penny & Co., rails, fishplates, &c., £6,053; Messrs. G. Wimpey and Co., permanent way, £33,136; Messrs. R. W. Blackwell, poles and overhead equipment, £3,860; Callender's Cable Co., feeder cables, £3,324; Westinghouse Co., cars, £8,662, and track sweeper, £740.

Margate.—The T.C. has accepted the tender of the National Telephone Co., Ltd., for the supply of 14 miles of lead-covered paper insulation dry core cable (20 S.W.G.) at £866.

Whitehaven.—The T.C. has accepted the following tenders for supplies to the electricity works:—The Reason Manufacturing Co. for meters and fuse boxes; the Stewart Electrical Syndicate, Ltd., for electric glow lamps; Messrs. Wilson & Kitchin, for dynamo spindle oil.

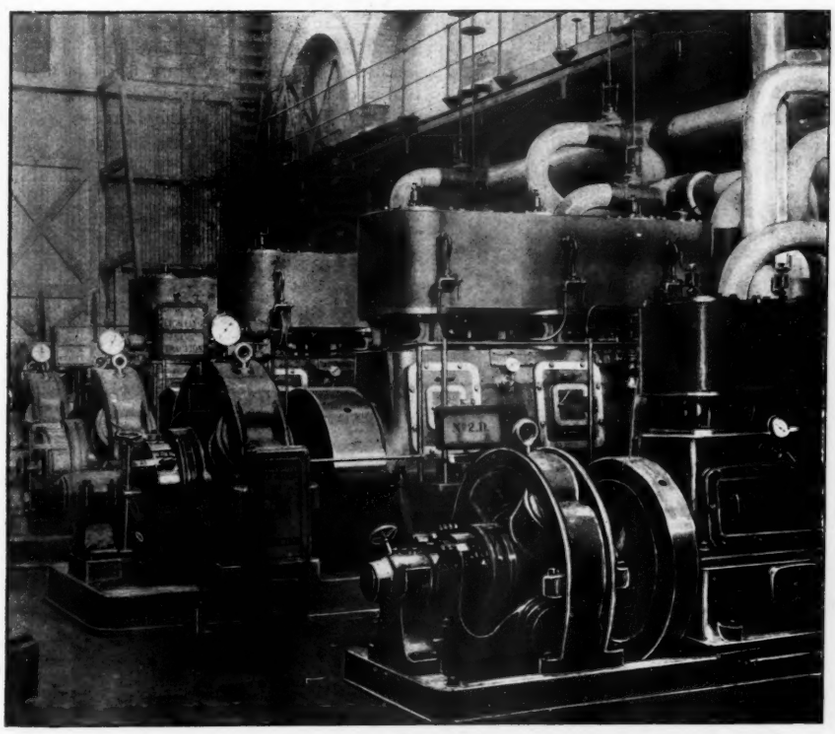
Yarmouth.—The following tenders for supplies to the electricity works have been accepted by the T.C.:—Blake and Knowles Steam Pump Co. for a pump at £67; Messrs. Mather and Platt, Ltd., Salford, for a 300-KW. steam alternator (Willans engine) at £2,623 5s.; Messrs. Carter & Wright, erection of chimney and extensions, at £3,674.

KIRKCALDY ELECTRICITY WORKS.

The history of electrical work in Kirkcaldy differs somewhat from the usual routine, for the Corporation obtained Parliamentary powers in 1899 to lay down electric tramways, whilst it was not until the following year that a prov. order was granted for electric lighting. Messrs. Kennedy and Jenkin were appointed consulting engineers in 1901, with instructions to prepare and carry out a combined electric lighting and traction scheme, and the contracts were duly let in accordance with their designs.

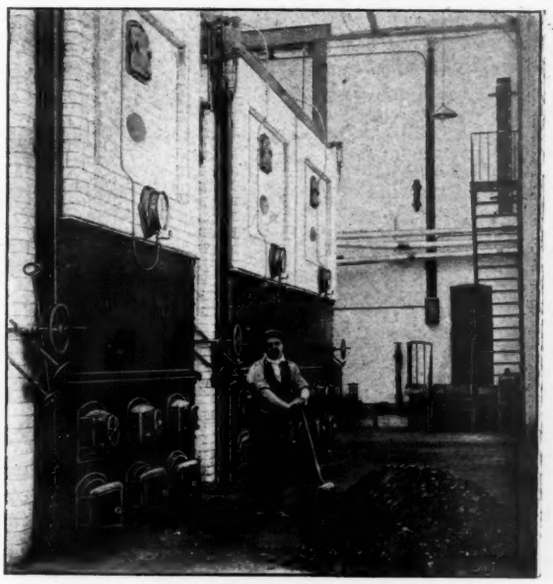
A commencement was made in November, 1901, with the laying of the permanent way, and cable laying began in February, 1902. The excavations for the power house were begun in February, 1902, and a large number of men were employed throughout the year in pushing on this portion of the work. The arc lamps were switched on for the first time experimentally on December 15th, and the supply of electric light began on December 23rd. The first trial run of the cars over the line took place on January 8th, 1903, and the Board of Trade inspection was held on the 8th ult.

The three-wire direct current system was adopted for lighting purposes, the current being supplied to consumers' lamps at a pressure of 230 volts. Electrical energy for lighting is charged for at the rate of 5½d. per unit, and for motive power at 2½d. per unit, with discounts. The tramways are supplied with energy at a pressure of 500 volts. Up to the present, applications for light and power have been received from 47 consumers, totalling over 3,000 8-c.p. lamps, and the town is lit with 49 arc lamps. The present tramway line, which is just over three miles in length, will have a service of eight cars; and the fares have been kept as low as possible, with frequent and liberal halfpenny stages.



View of Generating Plant.

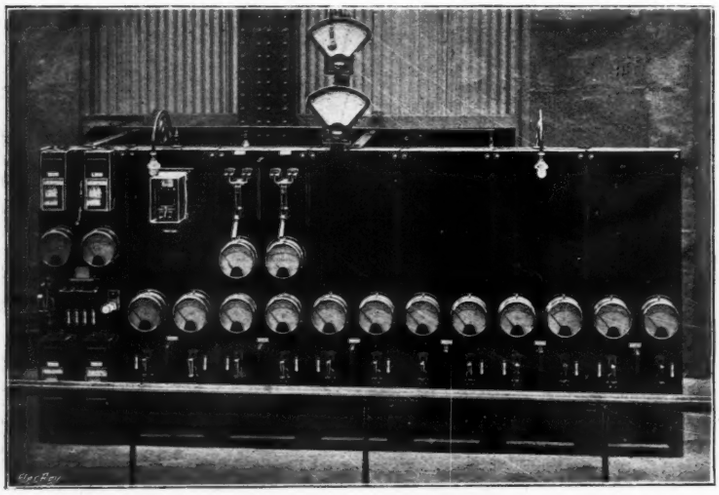
The power house has been made as far as possible fireproof, and has been designed with a view to carrying out extensions with the smallest possible further capital outlay. It is situated in Victoria Road, and is adjacent to the North British Railway harbour branch line, from which a siding for coal, &c., has been laid.



Stirling Boilers.

The boiler house contains three Stirling water-tube boilers, to work at a pressure of 200 lbs. per sq. in., each being capable of evaporating 13,000 lbs. of water per hour. The steam, feed and exhaust pipes, the feed pumps and feed-water heater, were supplied by Messrs. Aiton & Co. There are two 80-h.p. Browett-Lindley engines, each coupled to two shunt-wound balancer dynamos of 24-kw. output, supplied by Messrs. Laurence, Scott & Co., Ltd., and three 250-h.p. engines of the same make, each coupled direct to a compound-wound Laurence-Scott dynamo, capable of developing over 150 kw.; all the large sets are arranged for use either for lighting or for traction. The smaller engines are two-crank compounds, and the large ones three-crank compounds. The latter are of the enclosed, self-lubricating, vertical type, each developing 250 i.h.p. at 400 revolutions.

per minute, with 190 lbs. steam pressure, and exhausting into the atmosphere. The cylinders are 13 in., 17 in. and 17 in. in diameter, and the stroke is 8 in. The H.P. piston rod is 3 in. and the intermediate and L.P. piston rods are both 2½ in. in diameter; the crank-pin of the H.P. is 6½ in., and those of the I.P. and L.P. 5 in. in diameter.

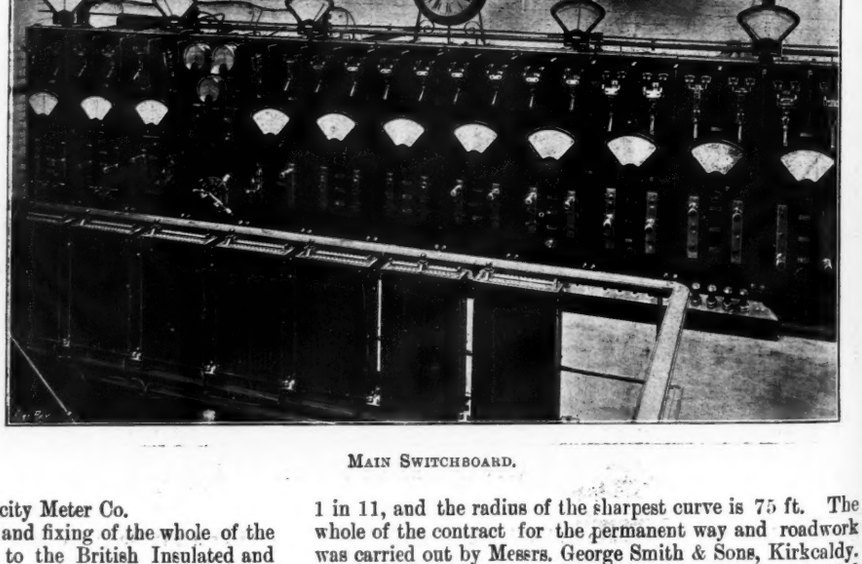


Traction and Arc Lighting Switchboard.

Two storage batteries of 131 cells each have been supplied by the Tudor Accumulator Co. The motor booster for charging the batteries, a milking motor-generator, the switchboard and connections, are by Messrs. Cox-Walkers, Darlington.

The travelling crane, supplied by Messrs. Carrick and Ritchie, has a span of 33 ft., and is designed for a load of 15 tons.

The cables were supplied and laid by Messrs. W. T. Henley's Telegraph Works Co., Ltd., their contract including all the feeders, distributing mains, arc light leads, the cables required for both traction and lighting, and all signal and telephone leads. The feeders are single conductor cables, laid in wood troughs on the solid system. The section boxes are equipped with the usual switches and fuses. The arc lamp-posts, brackets and switch-boxes were supplied by the Improved Electric Glow Lamp Co., Ltd. Messrs. Crompton and Co., Ltd., supplied and fixed the 10-ampere arc lamps (of which there are 49), switches and resistances. The arc lamps are arranged in series of five, between the outers and the neutral wire of the three-wire lighting system. The station and car shed wiring was executed by Mr. R. Bryson, jun., electrical engineer, Kirkcaldy. The ordinary meters were supplied by Messrs. Chamberlain & Hookham, whilst the prepayment meters were supplied by the Schattner Electricity Meter Co.



Main Switchboard.

The contract for the supply and fixing of the whole of the overhead work was entrusted to the British Insulated and Helsby Cables, Ltd., the poles and bracket arms being supplied to the contractors by Messrs. John Spencer, Ltd., Wednesbury. The work has been done as simply as possible, no ornamental base being provided for the pole, and no scroll work of any kind being fitted to the bracket arms. This somewhat new design was favourably commented on by the Board of Trade inspectors. Ambroin insulators, supplied by Messrs. Estler Bros., have been used throughout, except for the section insulators, which have been supplied by Messrs. R. W. Blackwell & Co., Ltd., and are of special design, arranged with side metallic flaps, so that current is never shut off from the car. This is a very useful feature for overhead work, where it is necessary to put the section insulators on a gradient. The section pillars have been made by the British Insulated and Helsby Cables, Ltd., using, in place of the ordinary switches, circuit-breakers of their own design. They have supplied, also, the special lamp-signalling apparatus, to Messrs. Kennedy & Jenkin's design. There are two trolley wires, and both centre and side poles are used, as well as brackets and span-wire, with rosettes where necessary. The trolley wire is 0·325 in. hard-drawn copper, and the guard wires are of 7/20 S.W.G. galvanised steel. The height of the poles above ground is 27 ft. 3 in., and of the trolley wire 21 ft. 6 in. The safety appliances consist of automatic cut-outs and disconnecting switches of the chopper type.

The length of track laid at present is 3 miles of single line, with passing places and junctions at certain places for probable extensions. The gauge is 3 ft. 6 in., and the distance between the centres of the lines at passing places 7 ft. 6 in. The concrete bed is 6 in. deep. The rails are of the usual girder type, weigh 87 lbs. per yard, and are in 45 ft. lengths; they were supplied by the Phœnix Co., Ruhrort. The fishplates are 20 in. long, weigh 42·5 lb. per pair, and have four holes; very few sole-plates are used. The bonds were supplied by Messrs. Dick, Kerr & Co. The paving adopted consists of granite setts, from 5 in. to 6 in. deep. The points and crossings were supplied by Messrs. F. H. Lloyd & Co., Ltd., Wednesbury. The heaviest gradient is 1 in 11, and the radius of the sharpest curve is 75 ft. The whole of the contract for the permanent way and roadwork was carried out by Messrs. George Smith & Sons, Kirkcaldy.

The British Thomson-Houston Co., Ltd., have supplied the Corporation with 10 complete cars. The car bodies

were built by Messrs. G. F. Milnes & Co., Ltd., for the B.T.H. Co., and are of the double-deck, single-truck type, with a seating capacity for 22 passengers inside and 26 outside. The outside length of the body of the car is 16 ft.; length over platforms, 26 ft.; total length over all, 27 ft.; width over all, 5 ft. 8 in.; and wheel base, 6 ft. The stairs are of the reversed type; the platforms are fitted with collapsible gates, and the cars are provided with combined wheel and slipper brakes. The interior is illuminated by five incandescent lamps, two of them acting also as signal

Cars Decorated for Opening Ceremony.

lights. The three lamps on the roof are fixed, one on the trolley standard, and one at each end on an extension of the hand rail. There are also two dash lights. All the lamps are for 100 volts, and of 16 c.p. The trucks are of the Milnes cantilever extension types with side frames, constructed of pressed steel, the wheels being 30 in. in diameter, and the axles 4 in. diameter in the centre, tapering to 3½ in. diameter at the journals. The lifeguards are of the Tidswell type. The electrical equipments consist of two G.E. 58 tramway motors, of approximately 28 h.p. each, the controllers being the well-known B.T.H. B-18. A special feature of the cars is the connection box with which each one is equipped for testing purposes, as well as the installation of a Thomson tramcar meter, whereby the energy consumption is recorded, so that comparisons can be made of the energy consumed by different drivers in operating their cars. The cars are further equipped with Spencer's type of run-back preventer. The trolley is the B.T.H. Co.'s B2 trolley standard, with a Towle head.

The car sheds are capable of holding 15 cars, with five tracks and a separate pit for each track. There are facilities for effecting repairs, but at present no machinery is installed.

Mr. Burbidge represented the engineers during the erection of the plant, &c. Mr. O. F. Francis is the burgh electrical engineer, and the Convener of the Electric Light and Tramway Committee is Councillor G. Fergusson. We are indebted to Mr. Francis for the particulars and photographs contained in this article.

The formal inauguration ceremony of the tramways took place on the 28th ult. Three decorated cars were used for the ceremony, in which members of the Town Council and their guests were conveyed over the lines, amid dense crowds. After the return of the company to the Town Hall the cars continued to run for public traffic.

In the course of the proceedings at the Town Hall, Councillor Fergusson, replying to a toast, stated that it was hoped to extend the tramways as far as Leven on the one hand, and Burntisland on the other; and additions would be made to convert the existing system into a circular route. The whole of the work had been carried out in 13 months. Councillor Kilgour said that the total cost had amounted to practically £90,000.

RECENT APPLICATIONS OF THE BRAUN-SIEMENS & HALSKE SYSTEM OF WIRELESS TELEGRAPHY.

By E. GUARINI.

A well-made, practical apparatus, guarded as far as possible against the unfavourable influences of atmospheric electricity and earth currents — an apparatus ensuring, to a certain extent, at least, secrecy with regard to the messages— this is the object aimed at by the wireless telegraph company working the Braun-Siemens & Halske system. We have already given a brief description of this system in the Electrical Review of April 18th, and a more detailed account in the number dated September 26th, 1902; and we have mentioned the successful trials made by the company in question between Cuxhaven and Heligoland. A recent report made by the inspectors of pilotage at Cuxhaven shows that the stations of Cuxhaven and of the lightship No. 1 of the Elbe worked with complete reliability, and remained in permanent communication with the Heligoland station. The distances between these various points are respectively: — From Cuxhaven to lightship No. 1, 33 km.; from lightship No. 1 to Heligoland, 32 km.; from Cuxhaven to Heligoland, 65 km.

In the summer of 1902 two new experimental stations were established on the Baltic by this company. These are

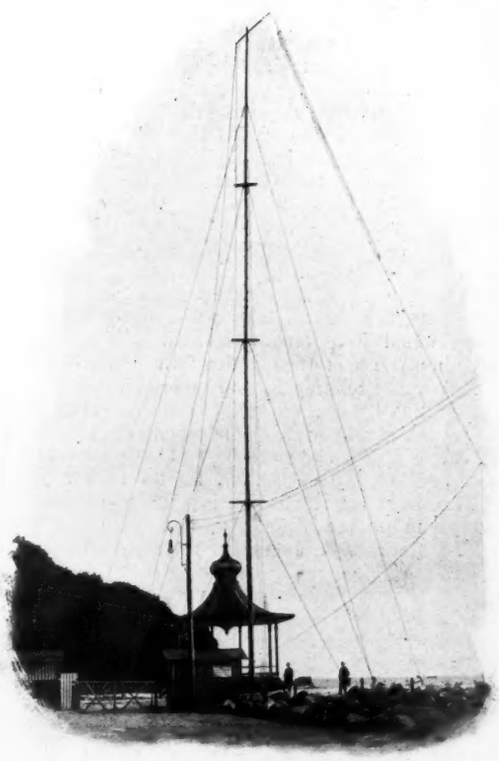


Fig. 1.—Transmitting Station at Sassnitz.

the Sassnitz station in the Island of Rugen (fig. 1) and the Gross Möllen station on the Pomeranian coast. Since

their completion they have worked with recording apparatus with perfect reliability over a distance of 165 km. At both stations a wire 75 m. long is brought at a sharp angle to the top of a mast 50 metres high. Along the upper third of its length this wire forms the centre of a strand of six parallel wires.

Fig. 2.—Military Wireless Telegraph Station: Marching Order.

This system has long been in use in the Austrian and Danish Navies. Reliable communication with the Morse recording apparatus had previously been established over a distance of 100 km. Several stations have also been established for the American Navy.

Lastly, the system was successfully applied at the time of the German military manœuvres. The battalion of aeronauts to whom was entrusted the wireless telegraph department had been provided with two fixed and three movable stations, which answered perfectly the purposes for which wireless telegraphy is required in military tactics.

Its object is twofold — to establish reliable and permanent communication between the various detachments of an army, and to maintain this communication throughout the most rapid military operations, *e.g.*, during the march forward of a division of cavalry.

As ordinary telegraphy cannot meet these requirements, attention has been directed to wireless telegraphy in this connection since its earliest days. But at that time it had neither the desired reliability nor the desired mobility.

The attempts made to utilise it during the Boer war gave such unsatisfactory results, that the idea of employing it for this purpose would have been abandoned if it had not been for the importance of the question from a military point of view. Wireless telegraphic communication would be of the greatest utility between the various detachments of an army, and particularly between an advancing and a stationary division. But it is also necessary that these communications should be absolutely reliable, for, from a military point of view, uncertain communication is worse than none at all. The system we are describing, and the employment of movable stations, have enabled these requirements to be realised.

The stations worked correctly over a distance of 100 km. In the first place, in order to attain this result, a greater elevation was given to the antenna, so that the waves should not be affected by the adverse influences of inequalities in the ground. In order to effect this greater elevation of the aerial wire, small captive balloons or kites were used to carry it up into the air. This, however, was not sufficient; in order to increase the range, it was necessary to strengthen the electrical effect. This Dr. Braun accomplished by placing the open oscillation circuit close to the closed circuit. The movable stations realised the second desideratum by following the most rapid movements of the troops. These stations consist of two vehicles In the rear one is the transmitter, and the source of energy, consisting of a dynamo and a benzine motor. In the front carriage are the receiver, the reserve parts and various military accessories. These carriages are kept in readiness for working. Fig. 2 shows them ready to start; fig. 3 shows them uncoupled and ready for work. The dynamo develops 2·5 kw. at 120 volts, 800 revolutions per minute. The benzine reservoir is under the carriage. On the right of the dynamo is the induction coil, which yields a spark of 40 cm. Above the dynamo is the condenser, consisting of 40 Leyden jars ·30 m. in length, by 2·5 cm. in diameter. The front carriage contains, on the right, the coherer and the relay. Beside them is the Morse registering apparatus. Under the carriage is the reservoir of hydrogen for inflating the balloons.

The Braun system is peculiarly applicable to these movable stations, as it does not require any connection to earth, and so does away with the trouble of selecting a favourable spot, which is often not to be found. During the manœuvres in question, the movable stations were of the greatest utility. It was in this way that constant communication was maintained between the commander-in-chief and the cavalry division. The stations worked reliably with the aid of the Morse registering apparatus during two days' march, or, with the aid of the telephone, during three or four days' march.

Fig. 3.—Military Station Ready for Work.

This was, therefore, a complete success for the Braun-Siemens & Halske system, which, however, does not pretend to work over great distances. What it aims at is to improve the instruments so as to ensure for them permanent and absolute reliability for such distances as are met with most frequently in practice. The Braun company is at present occupied with the tuning of different stations, and has obtained favourable results in this connection.

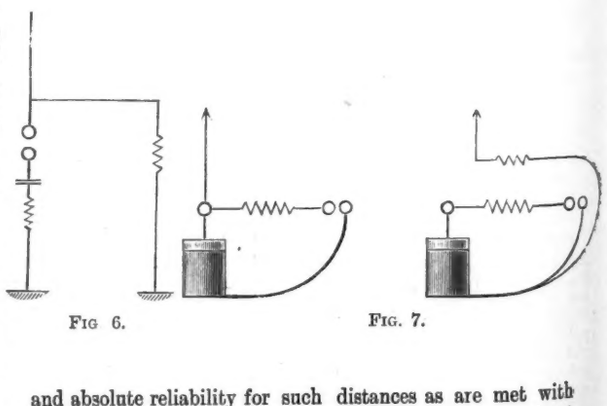


Fig 6. Fig. 7.

There has lately been a dispute as to priority between Dr. Braun and Prof. Slaby. Conferences were held with a view to a union of the two companies, but as Slaby demanded that his name alone should figure in the enterprise, negotiations were broken off.

The difference between the rival systems lies in the transmitter. Slaby's is shown in fig. 6 and Braun's in fig. 7. The arrangement of Braun in question is not the one used in the later experiments, but the one patented in 1898 in Germany and in 1899 in England. The Slaby arrangement, patented, it appears, after Braun's, consists of an antenna connected with a closed circuit consisting of the oscillator, inductance coil, and condensers, two earth connections completing the circuit.

The claim to priority made by Braun is based on the fact that if, in the Slaby system, instead of two separate connections to earth, one only were used, or if the two connections to earth were replaced by a conductor, the two arrangements (figs. 6 and 7) would be the same.

It is to be desired that, in the interests of the development of wireless telegraphy in Germany, the two systems should be united and worked in common by the two companies interested. This would pave the way to a solution of one of the questions to be discussed at the approaching Berlin conference, viz., the formation of a wireless telegraph trust, to be managed by a single company. Each inventor would bring his improvements to this company, and would receive a share in the profits in proportion to his contribution and to sacrifices made.

FORTHCOMING EVENTS.

Saturday, March 21st.—At 3 p.m. Royal Institution. Lord Rayleigh on "Light: Its Origin and Nature." (Lecture IV.)

Association of Engineers-in-Charge. Annual Dinner.

At 7.30 p.m. Glasgow Technical College Scientific Society. R. Baillie on "Stirling Water-Tube Boilers."

At 11 a.m. I.E.E. (Students). Visit to the Charing Cross and Strand Electricity Supply Co., 85, Commercial Road, Lambeth.

Monday, March 23rd.—At 8 p.m. Institute of Marine Engineers. "Water-tube Boilers," by A. E. Mills.

At 8 p.m. Society of Arts. Cantor Lecture IV., by Prof. J. A. Fleming, on "Hertzian Wave Telegraphy in Theory and Practice."

Wednesday, March 25th.—I.E.E. (Students). "Notes on Three-Phase Motor Design," by F. J. Hiss, jun.

At 3.45 p.m. I.E.E. (Birmingham). Visit to the Metropolitan Carriage and Wagon Co.'s works at Saltley.

At 7.30 p.m. I.E.E. (Birmingham). Prof. F. W. Burstall on "Power Transmission by Gas." Mr. A. M. Taylor will reply to the discussion on his paper on "Network Tests and Station Earthing."

Thursday, March 26th.—At 8 p.m. I.E.E. Adjourned discussion on "Distribution Losses in Electric Supply Systems," by A. D. Constable and E. Fawssett, and an abstract of a paper by Mr. M. B. Field, "A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms;" and, if time permit, "Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals," by W. Aitken.

Friday, March 27th.—At 8 p.m. Institution of Civil Engineers. Students' Meeting. "The Advantages of Motor-Driven Printing Machines," by J. G. Y. D. Morgan.

NOTES.

Junior Institution of Engineers.—At the meeting of this Institution, held at the Westminster Palace Hotel on March 6th, the chairman, Mr. Kenneth Gray, presiding, the paper read was:—"Practical Notes on the Use and Maintenance of Electric Motors for Factory Work," by Mr. W. T. George, member, electrical engineer at the Mazawattee Tea Co.'s works. There was an unusually large attendance. Descriptive notes on different types of motors, motor starting apparatus, were given; the advantages of electric driving over other methods were indicated, and the utility of keeping a record of all breakdowns, &c., as they occurred was dwelt upon. Observations on the general management of motors concluded the paper, which was followed by a discussion in which Messrs. G. C. Allingham, W. V. Treeby, Hal. Williams, A. W. Marshall, W. Anderson, M. Matthews, H. W. Allingham, G. Bullock, G. Gentry, and L. H. Rugg, took part.

Australian News. — From the February issue of *Australasian Hardware and Machinery*, we gather the following items of electrical news:—The Eltham (N.Z.) Borough Council has adopted an electric lighting scheme, and will shortly call for tenders. The Dunedin (N.Z.), electric tram installation by Noyes Bros. is being pushed forward. Col. Turrettini, the Italian engineer, cannot go to Christchurch to report upon the proposed utilisation of the Waiamakariri Falls for electrical purposes, and it is now hoped that the Premier will carry out his promise to get "a competent engineer from America," to advise on the water-power resources of New Zealand. The Wellington (N.Z.) Corporation has accepted the first instalment of contracts for cement, power station buildings, &c., for the electric tramway scheme. Messrs. Ganz & Co.'s Australasian agents have secured a contract for electric haulage plant for the Berry Consols Extended Gold Mining Co., in Victoria. The contract includes generating station, lighting machinery, and three locomotives. It is stated that there were several lower tenders, but Ganz & Co. got the work because of the satisfaction obtained with a similar plant put down by them at Rutherglen. Messrs. Splatt, Walt & Co., of Perth, are going to supply plant for a £7,000 electric lighting plant for the Subiaco Municipal Council.

St. Louis Exposition, 1904.—As we have already pointed out the electrical exhibits at next year's great exposition at St. Louis will form a most remarkable collection. We have received from Mr. G. F. Parker, the Exposition Commissioner in the United Kingdom (Sanctuary House, Tothill Street, Westminster), an advance proof of an article written by Mr. W. E. Goldsborough, chief of the Department of Electricity, describing in popular terms some of the features of the buildings, statuary and so forth of the Palace of Electricity. The efficient organisation of the exhibition is working energetically to keep the matter prominently before the attention of the world. How much interest English electrical manufacturers will take in the affair as exhibitors is a matter of extreme uncertainty at the moment, although we believe that some important firms have begun to move. Those who are not yet in possession of the general details should communicate with Mr. Parker as above without further delay. Mr. Balfour has now promised a Royal Commission to see that this country's part is efficiently performed. The appointment seems rather late in the day, seeing that the arrangements are now so far advanced, and there will be need for very energetic action and considerable enterprise if this country and its industries, &c., are to be adequately represented.

Obituary.—News has arrived by mail announcing the death, at his residence, 1,013, Clinton Street, Philadelphia, Penn., of General William Farrar Smith, who was in his 80th year. The deceased was declared by the victorious General Grant to be the only man fit to succeed him in the command of the Federal Army. To this testimony it is needless to add that General Smith, who had graduated at the military college of West Point as an engineer, had a distinguished military career. He retired from the army in 1867, and through Mr. Scrymser, now President of the Mexican, and of the Central and South American Cable Companies, and who had served as a captain on General Smith's staff, became President of the International Ocean Telegraph Co., whose cables connect Cuba with the State of Florida. General Smith took an active part in 1869 in the formation of the Cuba Submarine Telegraph Co. and of the West India and Panama Telegraph Co. He was a vigorous personality in these days, and retained his vigour until the last, for until a year ago he was Government engineer for the States of Maryland and Delaware. By a strange coincidence two other gentlemen who were interested in these undertakings, Sir George Chambers and Mr. Quinton Hogg, have quite lately passed away.

Lectures.—A lecture was delivered at the College of Science, Dublin, on the evening of the 14th inst. on "The Development of Electrical Energy Supplies," by Mr. Mark Ruddle, under the auspices of the Dublin Local Section of the Institution of Electrical Engineers. In the course of his lecture Mr. Ruddle said the problem before electrical engineers was to secure increased efficiency, and consequently lessened cost, in the general distribution of electrical energy. Much progress has been made in recent years in cheapening the cost to the consumer, but much more remains to be accomplished. Economy could be effected by improvements in the manufacture of storage batteries, and in the incandescent lamp itself, which has such an absurdly low efficiency. There was great necessity for a common agreed set of wiring regulations, and it was idle to contend that bad wiring was not more dangerous than bad gas fitting. The possibility of fire from bad and faulty installation work was, in a crowded city, a most dangerous thing to contemplate, and this could only be avoided by sound materials, good workmanship and good design. Electrical engineering seemed to be regarded as the lawful prey of some of the members of the older professions, with the result that electric lighting got a bad name through unsatisfactory work. Electrical engineers had not yet arrived at a thoroughly satisfactory method in the construction of systems of distribution, but he believed the time was approaching when a breakdown could be set right with as little inconvenience as the repairing of a burst water pipe. A discussion followed, and a vote of thanks to the lecturer was passed.

In the Theatre of the Royal Dublin Society, on the afternoon of the 13th inst., Prof. W. E. Ayrton, F.R.S., delivered a lecture on "Electric Rectifiers." He said that the object of his lecture was not to discuss the rectification of the alcoholic fluid—there were better authorities in Dublin on that subject than he was—he intended rather to deal with the rectification of the electric fluid. They might ask why electricity should want rectification, seeing

that the electric energy could not possibly be diluted or adulterated. The electric rectifier was required for converting an alternating current into a smooth direct current. They used the alternating current for the economical transmission of electric power. The lecturer then proceeded to explain the method by which great electric power was conveyed from a distant generating station to different localities, and then transformed so as to suit varying public and domestic purposes. This, he said, was what was to be done in the Dublin electric lighting scheme. An alternating current at 5,000 volts would be sent from the generating station at the Pigeon House to the central station in Fleet Street, and from that station distributed to 27 sub-stations, where the electric pressure would be reduced so as to suit the needs of the inhabitants, and where, in addition, the alternating electric power would be transformed into direct current to serve 500 arc lamps for public lighting, for the reason that alternating current was not so useful for public lighting. He illustrated by experiments how this transformation was effected, and said that an instrument to convert an alternating current into a steady direct current had been invented, which would be extremely useful to medical men in applying electricity to their patients.

On Wednesday last week a lecture was delivered before the ratepayers in the Town Hall, Govan, by Mr. James Brown, resident electrical engineer, on the subject of the electrical supply of the burgh.

Personal.—Mr. C. R. Bellamy, manager of the Liverpool Electric Tramways, arrived at Liverpool from New York on Saturday last. During his visit to New York, Mr. Bellamy has inspected the tramway systems of New York, Boston, Niagara, Buffalo, Detroit and Brooklyn. He found overcrowding to be practiced to a deplorable extent; but in the matters of inter-urban communication and the carriage of merchandise, the Americans were in advance of England. After seeing the American tramways, Mr. Bellamy came to the conclusion that none of them approached the Liverpool system for convenience of accommodation for passengers.

On Monday evening Mr. and Mrs. Bellamy were the recipients of handsome and valuable presents from members of the staff of the Liverpool tramways. The presentation took place at the annual concert of the Corporation Tramways Social, Athletic and Thrift Society which was held in the small concert room, St. George's Hall, and was made by Alderman Petrie, chairman of the Tramways Committee. The presents consisted of a massive silver tea and coffee service; a solid silver two-handled tray with inscription and monogram; a diamond pendant for Mrs. Bellamy, and an illuminated address in a gilt frame.

The Huddersfield Tramways Committee has recommended that the borough engineer, Mr. K. F. Campbell, shall be paid £300 for special and extra services rendered in preparing plans, specifications and drawings in connection with the electrification of the tramways.

Mr. R. MacKelvey, on leaving the service of the Isle of Thanet Light Railway Co., has been presented by the employés with a purse of gold. He has also been presented with an elaborate apron by the St. Peter's Masonic Lodge.

Mr. E. Samuels, late manager of the St. Helens area of the National Telephone Co., has been presented by the staff with a dressing case and umbrella on his departure for Southport.

Appointments Vacant.—An electrical assistant at the National Physical Laboratory at £150—200; a chief engineer for Fulham Workhouse at £180. See "Official Notices" to-day.

Manchester Canal Cranes.—The Manchester Ship Canal cranes, which were described in our issue of March 6th, were built and equipped to the specifications of Mr. W. H. Hunter, chief engineer of the Ship Canal Co., not as stated last week.

A Question of Etiquette.—A correspondent sends us a cutting from the advertisement pages of the *Transactions of the American Inst. E.E.*, in which the scope and value of "Science Abstracts" are duly set forth. We are surprised to note, however, that the editor's name appears, *not* as editor, but as "consulting engineer." This may, of course, be an oversight or an accident; obviously the unofficial title of the editor has no place in an official advertisement, and we presume that the error will be rectified in due course.

THE CENTRAL STATION ENGINEER.

Ashton-under-Lyne T.C., on March 10th, appointed Mr. J. Moss, of Manchester, as chief assistant at the Electricity Works. There were 118 applicants for the post.

The salary of Mr. W. A. Fraser, the borough electrical engineer at Nelson, has been raised from £300 to £350.

Mr. E. Goolding has resigned the post of chief assistant electrical engineer, with the Great Northern Railway of Ireland, to take up a position with the British Thomson-Houston Co., of Rugby, in its traction department.

NEW COMPANIES REGISTERED.

Jerrard's Automatic Track Cleaners, Ltd. (76,512).—This company was registered on February 25th, with a capital of £5,000 in £1 shares, to acquire and turn to account inventions relating to cleaning and burnishing the rails, bars and the like of permanent ways over which electric trams, trains, motors and similar vehicles run, and to the economising of electric power, and in particular to acquire from C. H. Jerrard, of 204, High Street, East Ham, the benefit of certain existing inventions relating to the cleaning of tram rails. The first subscribers are:—Lewis Levy, 600, Commercial Road, E., merchant, 250 shares; Lawrence Levy, jun., 600, Commercial Road, E., 162 shares; C. H. Gausden, 600, Commercial Road, E., clerk, 1 share; H. Chetham, 25, Finsbury Square, E.C., solicitor, 183 shares; C. A. Cohen, 25, Finsbury Square, E.C., solicitor, 92 shares; B. Cohen, 600, Commercial Road, E., merchant, 173 shares; and M. G. Cohen, 600, Commercial Road, E., merchant, 259 shares. No initial public issue. The number of directors is not to be more than seven; the first are Lewis Levy (chairman), C. H. Jerrard, H. Chetham and B. Cohen; qualification, £50. Registered office, 598, Commercial Road, E.

A.B.P. Accumulator Co., Ltd. (76,438).—This company was registered on February 19th, with a capital of £20,000 in £1 shares, to acquire the accumulator department of the business of Ashmore, Benson, Pease & Co., Ltd., including Patent No. 22,143, dated October 6th, 1900, granted to E. C. H. T. Lugard, in respect of an invention for improvements in electrical accumulators, to adopt an agreement with Ashmore, Benson, Pease & Co., Ltd., and E. C. H. T. Lugard, and to carry on the business of accumulator manufacturers, electricians, engineers, suppliers of electricity for light, heat, power or otherwise, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—E. Schweich, 20, Hyde Park Square, W., engineer; R. S. Benson, Parkfield Works, Stockton-on-Tees, engineer; C. E. Lugard, Hazelhurst, Saltburn-by-the-Sea, engineer; T. A. Pallister, Parkfield Works, Stockton-on-Tees, secretary; B. Beard, Parkfield Works, Stockton-on-Tees, engineer; W. F. Smithers, Ivy House, Woodlands Road, Middlesbrough, engineer; and J. E. Hannan, 4, Ashburton Terrace, Linthorpe Road, Middlesbrough, book-keeper. No initial public issue. The number of directors is not to be less than two nor more than five; the first are E. Schweich, R. S. Benson and E. L. Pease; qualification, £100; remuneration as fixed by the company. Registered office, Parkfield Works, Stockton-on-Tees.

B. Bridgwater & Co., Ltd. (76,522).—This company was registered on February 26th, with a capital of £2,000 in £1 shares, to acquire the business carried on at 78, York Road, King's Cross, as "B. Bridgwater and Co," and to carry on the business of constructional and electrical engineers, art metal workers, tool manufacturers, &c. The first subscribers (each with one share) are: B. Bridgwater, sen., 35, Raleigh Road, Hornsey, constructional and electrical engineer; B. Bridgwater, jun., 51, Hampden Road, Hornsey, constructional and electrical engineer; S. Bridgwater, 16, Bolitho Villa, Barnsbury, constructional and electrical engineer: H. Bridgwater, 84, Raleigh Road, Hornsey, builder and contractor; Miss A. Bridgwater, 84, Raleigh Road, Hornsey; W. Childs, 64, Cumming Street, Pentonville, cashier; and F. C. Evans, 367, Birkbeck Bank Chambers, W.C., solicitor. No initial public issue. Registered without articles of association.

Ljungstrom Engine, Boiler and Condenser Co., Ltd. (76,588).—This company was registered on March 4th, with a capital of £66,500 in £1 shares (15,000 preference), to acquire (*a*) the benefit of certain existing inventions and patents in relation to balanced rotary steam engines and steam generators and evaporators (known as "Ljungstrom patents"): (*b*) the undertaking of the Ljungstrom Engine Syndicate, Ltd. (incorporated 1901, and now in liquidation): and (*c*) certain other boiler condensers and other property and rights, to adopt agreements (1 and 2) with B. Ljungstrom, F. Ljungstrom, C. Cervin and K. Tillberg; (3) with the Ljungstrom Engine Syndicate, Ltd., and its liquidator; and (4) with T. W. Elliott, and to carry on the business of mechanical, electrical and general engineers, machinists, tool makers, metal founders, workers, converters and merchants, metallurgists, boiler makers, millwrights, fitters, smiths, &c. The first subscribers (each with one share) are:—E. W. Spencer, Newbiggen House, Kenton, Northumberland, managing director; C. N. Backhouse, Bank, Darlington, bank director; J. Spencer, Whorlton Hall, Newcastle-on-Tyne, director; G. E. Henderson, 16, Framlington Place, Newcastle-on-Tyne, director; M. Dillin, 17, Victoria Square, Newcastle-on-Tyne, secretary; R. Philipson, Priors' Terrace, Tynemouth, director; and T. W. Elliott, Monkseaton, Northumberland, gentleman. No initial public issue. The number of directors is not to be less than five nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

ELECTRIC TRAMWAY ACCOUNTS.

Liverpool Corporation Tramways.

The tramways undertaking of the City of Liverpool shares with that of Glasgow the distinction of being one of the two largest and most complete systems in this country.

During the past year some short extensions to route have been made, one of which—from Old Swan to Knotty Ash—is of greater importance than appears at first sight, as it joins up to the Liverpool and Prescot light railways section of the South Lancashire tramways, and provides a continuous route to St. Helens, Bolton, Wigan, Leigh and adjoining towns, Swinton, Salford, Manchester, Bury, Rochdale, and Oldham, and, in fact, all the tramway systems of South Lancashire. This, in view of the influential movement which is on foot to provide by means of electric tramways a more flexible system of collecting and conveying merchandise from the Liverpool Docks for distribution over the above area, gives promise of developments which can hardly fail to greatly increase the importance of the Corporation's undertaking. A portion of the routes are rented and energy purchased on those sections from the Borough of Bootle, the energy used elsewhere being supplied by the Liverpool Corporation electrical department. The maximum gradient is 1 in 14. The following figures serve to indicate the position of the undertaking since 1898:—

	1898.	1899.	1900.	1901.	1902.
Passengers	41,772,084	63,771,450	82,367,958	101,108,780	109,835,585
Mileage	6,279,758	7,600,546	9,100,866	10,970,063	11,790,815
Receipts	£314,207	£359,929	£417,574	£468,383	£506,728

During 1902 the passengers carried were conveyed—108,906,472 by electric car, 74,685 by horse car, and 354,428 by omnibus (which was discontinued in August).

Mr. C. R. Bellamy, A.M.I.C.E., is the general manager, and to his go-ahead policy the inhabitants of Liverpool are indebted for the efficient working and many original improvements which characterise the system.

Period covered by returns.	12 months.	12 months.
Date ending	Dec. 31, 1902	Dec. 31, 1901.
Date of opening (electrical) ...	Nov. 16, 1898	—
Length of route	51 miles	—
Total length of track	101 miles	—
Average number of cars in use	380	355
Car-miles run	11,790,815	10,970,063
Electrical energy used	16,855,113 units	14,333,592 units
Passengers carried per annum ..	109,335,585	101,108,780
Capital expenditure to date ...	£1,832,977	£1,730,222
Traffic receipts	£506,728	£468,383
Total receipts	£517,935	—
Working expenses	£339,811 = 65 % total rev.	
Gross profit	£178,124 = 9·7 % capital	
Income per car-mile	10·34d.	10·32d.
Working expenses per car-mile	6·88d.	6·78d.
Interest, sinking fund and depreciation per car-mile ...	2·08d.	2·09d.
Total expenses per car-mile ...	8·97d.	8·87d.
Profit or loss per car-mile ...	+1·37d.	+1·45d.
Average fare per passenger ...	1·11d.	—
Average length of 1d. stages ...	2¼ miles	—
Revenue per mile of route ...	£10,155	—
Expenditure per mile of route...	£6,663	—

During 1902 the energy used has increased by 17 per cent. ove the previous year, and was supplied, by Liverpool, 15,915,332 units, and by Bootle, 939,781 units.

The average price paid for energy, including all charges, delivered into the feeder boxes, amounted to 1·99d. per unit. During the year the total number of cars has been increased to 488—429 being the greatest number in use on any one day. On various occasions some 356 special cars have been provided. As an instance of the traffic dealt with, it will be noted that in the busy season 5,550 cars arrive at and depart from the Pierhead, and a total of 7,352 cars run in and out of the city per day.

In connection with the system there are four car sheds, and a car-building and repair works, employing 357 hands, which during the year dealt with 3,595 cars; these ran on an average 3,306 miles before requiring attention.

Analysis of Working Expenses.

		Per car-mile. 1902. d.	Per car-mile. 1901. d.
Electrical energy	£82,753	1·696	1 612
Wages: drivers, conductors, inspectors, &c.	119,089	2·441	2 428
Rental of lines, acknowledgments ...	6,017	·123	*·004
General charges, including rent, rates and taxes and insurance, management and office expenses, &c	39,237	·804	·810
Sundry charges, licenses...	3,404	·069	·060
Travelling, cleaning cars, sheds, lighting routes	14,331	·292	·287
Printing, stationery	885	·018	·024
Tickets, punches	2,643	·054	·056
Uniforms, &c.	4,250	·086	·090
Repairs and Maintenance—			
Rolling stock	37,178	·770	·855
Permanent way	14,000	·287	·227
Electrical equipment	6,223	·127	·199
Buildings and sundry	4,173	·085	·103
Tools and machinery	1,600	·032	·025
Total working expenses	£335,783	6·88d.	6·78d.

* Acknowledgments for fixing rosettes only, rental included in general charges.

During the year the total working expenses per car-mile have increased fractionally. Among the items, general charges, energy, and permanent way repairs show increases which are counterbalanced by a considerable decrease in repairs, &c., of rolling stock and electrical equipment.

That the working expenses per car-mile at Liverpool are higher than in several other well-known municipal systems may be attributed to the extensive services provided, which always tends to increase that item at the expense of the receipts—the travelling public, however, reaping the advantage.

Of the gross profit of £178,124, financial charges absorbed £102,627, leaving a balance of £75,497; from this £50,331 was transferred to the reserve, renewal and depreciation fund, which now amounts to £118,317, or over 6 per cent. on the capital, and £25,166 to the general rate account.

Profit Statement.

Sinking fund (tramways and reconstruction, &c.)	£51,924
Interest on loans	50,703
Reserve, renewal and depreciation fund	50,331
Transferred to general rate	25,166
Gross profit	£178,124

ELECTRICITY SUPPLY ACCOUNTS.

Walsall Corporation Electricity Accounts.

During 1902 the electrical undertaking of the borough of Walsall has not proved so satisfactory, financially, as in the previous year. The revenue has risen steadily, but expenses show a great increase compared with previous years, and the gross profit is £21 less than in 1901.

During the year the department has for the first time acquired a small traction load. The chief engineer is Mr. Alex. Wyllie.

General Statement.

Year ending December 31st.	1901.	1902.	Inc.
Total capital expenditure ...	£43,339	£56,540	£13,201
Number of units sold	340,232	444,356	104,124
Maximum load in kw.	347	442	95
Equivalent 8-c.p. lamps connected	18,961	20,626	1,665
Number of public arcs	19	19	—
Gross revenue	£5,592	£6,586	£994
Gross expenditure...	£3,395	£4,410	£1,015
Gross profit	£2,197	£2,176	—£21
Average price per unit sold ..	3·88d.	3·51d.	—·37d.

The revenue for the year shows an increase of £994 as compared with an increase of £899 in the previous year; the increased units supplied over the previous year amounting to 104,124, compared with 64,589 units increase in 1901. If, however, the 87,494 traction units were deducted, the yearly comparative increases would be, 1901, 64,589 units; 1902, 56,862 units; or a considerable decrease in private supply, which, coupled with the fact that the traction load has not decreased the works costs per unit but has largely decreased the average price per unit, may account for the unsatisfactory result mentioned above. The following units were supplied:—29,280, public lighting; 327,582, private lighting; 87,494, traction; and the energy receipts were made up as follows:—Public lighting, £488; private lighting, £5,051; power, £427; and traction, £729. The prices charged are:—Lighting, maximum demand system, 6d. per unit for 1½ hours, and 2d. after, with discounts; power, 2½d. per unit for 2½ hours, and 1d. per unit after.

Revenue Statement.

	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Sale of energy	£5,492	3·88d.	£6,466	3·51d.	·37d.
Meter rents	100	·07d.	120	·06d.	·01d.
Sundry	—	—	—	—	—
Gross revenue ...	£5,592	3·95d.	£6,586	3·57d.	·38d.

The total works costs per unit are practically stationary, the effect of the small traction supply on the load factor being unnoticable. The item for coal shows a slight increase of ·10d. per unit; repairs have gone down by ·18d. per unit, and in the total are upwards of £100 less than in 1901.

Cost of Production.

For the year ending Dec. 31st—	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Coal..	£1,140	·80d.	£1,657	·90d.	·10d.
Oil, waste, water, and engine room stores.	203	·14d.	336	·18d.	·04d.
Salaries and wages incurred in generation and distribution, and attending street lamps.	603	·43d.	739	·40d.	—·03d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and public lamps.	730	·52d.	636	·34d.	—·18d.
Works cost ...	£2,676	1·89d.	£3,368	1·82d.	—·07d.
Rent, rates and taxes ..	336	·24d.	434	·24d.	·00d.
Management expenses, salaries of engineer, secretary, clerical staff.	259	·18d.	393	·21d.	·03d.
General establishment charges, stationery, printing, law charges and insurance.	124	·09d.	215	·11d.	·02d.
Total costs ...	£3,395	2·40d.	£4,410	2·38d.	—·02d.

As previously stated, the gross profit for the year shows a decrease of £21 compared with 1901, and during the same period financial charges have increased by £604 to a total of £2,419, which with an available gross balance of £2,175, leaves a deficit of £244.

The total surplus of the two previous years amounted to £382.

Profit Statement.

	1901.	1902.
Interest on loans	£1,070	£1,317
Sinking fund repayments	745	1,102
Balance carried forward	382	—244
Gross profit	£2,197	£2,175

CITY NOTES.

The Metropolitan Electric Supply Co.

The 16th ordinary general meeting of the shareholders of this company was held on Tuesday at Winchester House, Old Broad Street, Mr. W. H. Cripps in the chair.

The Chairman, in proposing the adoption of the report, said that the capital expenditure during the year had amounted to £226,717, and brought that item up to a total of £1,846,448. The amount spent last year was very heavy, but there were two large items which accounted for two-thirds of the amount. £96,000 had been spent in Willesden, and £56,000 in Marylebone. At the commencement of the year they had five large engines of 1,500 kw., each installed and in working order, at Willesden. During the year they had erected and installed a magnificent engine of no less than 3,000 kw., and a second one of similar size was also in course of erection. When those two engines were at work they would practically double the capacity at Willesden, as either one of them was capable of supplying something like 100,000 lamps. When they had got to those very large units it was quite impossible to extend their station by driblets—they had to make a very large expenditure in one year instead of spending it on smaller engines over several years. The effect would be that at the end of this year they would have sufficient plant at Willesden, he hoped, to supply their needs without spending anything like a large amount of new capital for a period of at least three or four years. They must remember that although these large engines had been partly paid for they had not yet earned any dividend, so that the benefit from them would not come in this year; but he hoped it would be seen in next year's accounts. As regarded the £56,000 spent in Marylebone, that was almost entirely spent upon the conversion of the alternating into the continuous current, and that sum they were entitled to receive back from the Marylebone Borough Council. Coming to the question of revenue in the past year, the total revenue was £261,000, compared with £236,000 the previous 12 months—an increase of £25,000. As regarded lamps last year they had 641,000 lamps; this year they had 723,000, or an increase of 82,000 lamps in the year. That was the largest increase in lamps they had ever had in one year, and it was satisfactory to know that so far as they had gone in the current year, the increase was continuing in the same proportion. As against the increase in revenue, came the question of the cost at which it was produced. In 1901 the cost was £112,000; the past year the cost had been £113,000 odd, in others words, it had only cost them a little over £1,000 to produce an increased revenue of £25,000. He thought they would consider that satisfactory, but he did not think that they had got to the bottom of their costs by any means, as they had every hope that when they got the large engines at work in Willesden, the cost of production would be still further reduced. One item which might seem a rather large one, was that of repairs, but that was chiefly due to the large number of small units that they were working from in their London station, but as they had sold part of this machinery, they would hope to benefit in the way of repairs in the future. Another notable increase was in rates. They had increased very largely, owing to the quinquennial re-valuation this past year, and he could not give them any hopes of a reauction in the future. So long as municipal bodies were seized with a craze for trading, so long would they have to pay more in rates, and where it would end goodness only knew. The Parliamentary charges were also high, but that was due to the action of the L.C.C., about which he would speak presently. They had put by the same sum for depreciation as last year—£10,000, and they considered that ample, especially taking into consideration the fact that they had no longer to put aside any depreciation for Marylebone, and that the L.C.C. was under the obligation of putting them up an entirely new station, with new machinery, in their Sardinia Street district. With the proposed addition, the depreciation fund would approximate to £100,000. The net result of the year was that after paying all charges, there was a balance of £73,873. £35,000 of that had already been distributed last October in the form of an interim dividend. That left £38,873 in hand, and the directors proposed that 7s. 6d. per share should be paid to complete the dividend, which would absorb £37,500, and make a total dividend for the year of 14s. 6d. per share, equal to a rate of 7¼ per cent. When they looked back and considered what their progress had been during the last few years—5 per cent., 6 per cent., 6½ per cent., and now 7¼ per cent., he thought they would be satisfied for the moment. There were two points about general policy and the general condition of the company to which he would like to refer. The first was as regarded the action of the L.C.C., who, year by year, had been putting them to considerable Parliamentary expenses in protecting their interests. As they knew, the company was working under the Electric Lighting Acts, 1882 and 1888, and it was on the strength of these Acts that the shareholders put their money into the concern. The L.C.C. last year and the year before, and again this year, were introducing a Bill into Parliament, which to his mind very seriously affected their interests. There were two special clauses in that Bill to which he wished to call their attention. The first was as regarded Willesden. When they went to Parliament six years ago for power to put up their Willesden station, the L.C.C., after being represented by the ablest counsel at the bar, did all they could to get Willesden put under the Electric Lighting Act. That meant that at the end of 35 years from that time the L.C.C. would have been able to buy Willesden at what he called old iron price. They fought that clause, and put before the Committee the fact that with such a clause it would be impossible to get the money for putting up the station. Now that it was put up it was one of the most magnificent stations in the world, and they had put over half a million of money into it. The L.C.C. had now actually introduced a clause into their Bill this year to put Willesden back again into the Electric Lighting Act, so that at the end of 29 years they would have to part with it for a mere song. Of course they were opposing that Bill. There was another clause in the Bill. Under the Electric Lighting Acts of 1882 and 1888 it was provided that at the end of their concession, which was in 1931, the Borough Councils or local authorities should have the right to buy so much of their works as was in their respective districts at what he would again call old iron prices. They who had given consideration to the question had come to the conclusion that long before their concession came to an end electric lighting works would be so gigantic that it would be absolutely impossible for any local body to buy the little bit in their own district. The L.C.C. wanted to take powers for the various local authorities to combine to buy the company out at the end of the term, and if they failed to do so the L.C.C. itself was to be able to buy them at old iron prices. That was almost as bad as trying to get Willesden, and they would strenuously oppose the Bill. The second reading came on on March 25th, and he hoped the shareholders would try and get their members in Parliament to oppose it. The other matter he would like to refer to was the sale of a portion of their undertaking to the Marylebone Borough Council. After repeated attempts to arrive at a settlement, they consented to sell under the Lands Clauses Act, and the matter was referred to arbitration, Mr. Russell, K.C., being appointed umpire. That arbitration had involved an immense amount of work on their officers and staff. It had necessitated 100 consultations, 33 days in Court, and over 11,000 questions had been put and answered. The result, of course, was as always happened in such cases—both parties were disappointed. The Borough Council thought they had had to pay too much, while they on their part thought they had got too little. He trusted, however, that the shareholders would make up their minds to be fairly satisfied with the award of £1,212,000. Let them remember that that did not include the amount they had spent in Marylebone since the notice to treat was given. They would be anxious to know when they would get the money; that they would get it there was not the slightest doubt. It must, however, be a matter of some little time before the financial arrangements were absolutely made, but he believed they might rely upon getting the whole of it well within the year. As regarded the question of getting in further capital to carry on the concern, of course that must depend to a certain extent upon when that money was received. When they got the money they would call the shareholders together and advise them as to what they wished done with it, and also as to whether it was desirable to alter the present capital condition of the company or not.

Sir J. Pender, Bart., seconded the motion.

Replying to the questions of several shareholders, the Chairman said that the debenture capital would require careful consideration as to how they were to protect their debenture holders when they had parted with a portion of the undertaking. As to the costs of the arbitration, they were borne by the Borough Council, but, of course, over and above the taxed costs, which they would get back, there must be certain other expenditure which they had incurred, and which would have to be paid by themselves. The whole cost of the arbitration would come to something like £60,000, only a very small fraction of which would fall upon the company. The amount of capital that they had put into Marylebone was just over half a million, and what they got was rather more than double, so he did not think they need complain. As regarded the loss of revenue they would suffer, that was rather difficult to tell. During the next two years certainly they would have very little loss, because they would have to supply the Council, and as to the future, it would, of course, all depend as to whether the Borough Council decided to put up their own station or to take their supply from the company, which would, of course, be much cheaper.

The report was then adopted.

Mr. Read proposed a vote of thanks to the chairman and directors and staff for the satisfactory manner in which they had carried through the arbitration, and gave notice that at the next meeting he would propose that those services be rewarded in a pecuniary manner.

The resolution was carried.

Oldham, Ashton and Hyde Electric Tramways, Ltd.

Mr. Garcke presided at the meeting held on Wednesday last week at Hamilton House. He said that the position of the undertaking was in every way satisfactory. The permanent way, rolling stock and other plant were being maintained in a condition of good repair and efficiency, and they were placing a sufficient sum to a sinking fund for depreciation and reserve in order to provide for all possible contingencies. After discharging all obligations, they were able to pay a satisfactory dividend of 8 per cent. on the ordinary shares for the year. The year had not been a thoroughly satisfactory one from a tramway traffic point of view. The summer was a

very unfavourable one as regarded the weather, and there was no factor that was so important as that bearing upon tramway receipts. Notwithstanding that, the traffic receipts had improved, and they had carried 5,240,000 passengers as against 4,900,000 in the preceding year, and the receipts had amounted to £27,780 as compared with £26,000. The average receipt per passenger had been 1·27d., the same as in the preceding year, but the average expenditure had been 1d. less, so that the percentage of expenditure to receipts had been slightly less. The trade of the district was now fairly satisfactory, and they looked forward to a year of satisfactory working; £2,000 was to be placed to depreciation and reserve fund, leaving a balance of £123 12s. 9d. to carry forward to the next account. The total capital expenditure was £135,409, but the issued capital was only £130,000. They proposed, therefore, to make an additional issue of £10,000, half in ordinary shares and half in preference, and they had offered them to the shareholders at the price of £22 10s. for two shares, one of each class, and it was indicative of the satisfaction the directors felt in regard to the position of the company, that, although the list was not yet closed, they had already received applications in excess of the number to be placed to the extent of about 60 per cent., and he expected that before the list was closed the shares would have been applied for twice over. The additional capital was required for the purpose of the extension which they had carried out, and for providing additional rolling stock. They would probably notice in the accounts a figure of £803 17s. 11d, which was the balance of the cost they had incurred in opposing the application for powers by adjoining local authorities. They were not successful in their opposition, but the expenditure was not altogether thrown away, as it resulted in their negotiating with the Hyde Corporation, the Stockport Corporation and the Romiley authorities for a lease for an extension of the tramways beyond Hyde, and for running powers up to the boundary of Stockport. There was an expenditure of £2,187, which had been on account of the construction of the extension lines, which had been leased to them by the Hyde Corporation. That expenditure was repayable to them by the Hyde Corporation, and as a matter of fact, a large portion of it had been paid since the closing of the accounts. At the time of the formation of that company, they were all alone in the district working electric tramways, but such had been the example set by the company of the good work that could be done by electric traction, that they were now practically surrounded by electrical tramways. They had not got physical junctions with the adjoining tramways, as their neighbours were too jealous to recognise the advantage that would be gained by such a connection. However, their passengers were able, by changing cars, to go throughout the district right up to Manchester and Stockport and various other places. He moved the adoption of the report, which Mr. Atherley Jones, K.C., M.P., seconded.

The report was adopted.

Hove Electric Lighting Co.

The eleventh annual general meeting of the shareholders of this company was held on Thursday of last week at Salisbury House, London Wall, Col. A. J. Filgate, the chairman, presiding.

The Chairman, in proposing the adoption of the report, said he thought he was justified in congratulating the shareholders on the results obtained in working the undertaking, and the progress of the business in the past year. The capital expenditure during the year amounted to £17,304, bringing the total expenditure on capital account up to £127,103. The bulk of the outlay last year was in connection with the new generating station which was now nearly completed, and which would be in full working order to meet the autumn and winter load. The total cost of the new station and its equipment, together with the necessary mains, would amount to about £35,000. That was a large figure, but the matter had received very careful attention, and they believed the investment would prove remunerative. The remaining capital expenditure, consisted of £3,321 on additional mains and strengthening existing mains and house connections, and changing over customers on the 110 volts to the 220 volts. They had increased the length of their mains by 965 yards, and their total length of mains now measured 17 miles 845 yards. To meet the capital outlay during the year they issued the 255 shares remaining out of the last issue at £7 10s. and £7 15s. per share, and called up the whole of the money due on that issue. They also placed £11,370 of additional 4 per cent. debenture stock. They had this year offered the debenture issue to the shareholders, and had placed a further sum of £6,730, and later on they proposed to make a further issue. The number of houses on the system on December 31st last was 1,040—an increase during the year of 119 houses. At the close of the year, the lamps and motors on the system reached the equivalent of 69,924, 8-c.p. lamps, against 61,366 at the end of 1901—an increase of 8,558 8-c.p. lamps; and the units sold to customers during the year amounted to 735,316 compared with 629,427 in 1901, an increase of 105,889 units, or nearly 17 per cent. The gross revenue of the year amounted to £17,562 compared with £15,518 in 1901, an increase of £2,044. The expenditure had amounted to £7,519 against £7,236, an increase of £283. Allowing, however, for the full outlay on maintenance and repairs during the two years, the actual expenditure had been £7,803 in 1902 and £7,423 in 1901. They were fortunate in obtaining their coal on more satisfactory terms, and notwithstanding their larger output the coal bill was only £21 in excess of the previous year. The net revenue of the year amounted to £10,043 compared with £8,282 in 1901. With the balance brought forward and interest on deposits, the sum they had to deal with in the profit and loss account was £10,156. From that had to be deducted interest on debentures and loans £1,314, and the interim dividend paid in October of £2,203. That left a balance of £6,638, and they recommended that £2,500 should be placed to the reserve account; £500 to the maintenance reserve account; and to declare a final dividend at the rate of 10 per cent. per annum for the half-year on the paid-up capital, making with the interim dividend 8½ per cent. for the year. They had already placed the premiums realised on the shares placed last year—£676—to the reserve fund account, and with the addition now proposed that fund would stand at £24,326. He would like to draw attention to the steady increase in the business. The number of units delivered to customers in 1900 was 94,000 in excess of the delivery in the previous year; 1901 showed an increase of 90,000 units over 1900, and the units consumed in 1902 were 105,000 in excess of the consumption in 1901. He was glad to say the progress was continuing, as in the first 10 weeks of this year the units delivered showed an increase of 22,213 compared with the same period of 1902. 1,029 additional lamps had already been connected this year up to date, and 1,339 more were waiting. Their average receipts for current delivered to customers came to a little under 5½d. a unit, and their average receipts per 8-c.p. lamp to under 4s. 10d. a year. With the reduction in charges the revenue per lamp had decreased, and their profits were only secured by close attention and strict economy on the part of the staff. Although they were incurring heavy additional capital outlay, they believed it to be fully justified, and hereafter while reducing the charge for electricity they hoped not only to maintain the present dividend, but before long to increase it. They had thought it desirable to call attention in the report to the action they had found it necessary to take regarding the change over from 110 volts to 220 volts pressure. They had never been able to understand why the Hove Corporation had assumed the attitude they had in the matter. They had frequently inquired the cause of their objections, but had never been able to elicit any explanation. They expected that the Corporation would have said something tangible before the Board of Trade inquiry, which they informed them they were most anxious to have, but their contention there was limited to a statement that the proposed change was not in accordance with the terms of the agreement transferring the Corporation's rights under the order to the company, and that the change was not desirable. How they could reconcile that position with their action in allowing them in 1898 to supply all new customers at a pressure of 220 volts, and, further, in drawing up their own scheme for the parish of Aldrington when they notified their intention of installing the current in that parish at a pressure of 220 volts, it was difficult to understand. They had not yet heard officially that their application to be allowed to change over the consumers on 110 volts to 220 volts had been granted, but they had no reason to doubt that would be the case. They were most anxious to work in harmony with the Corporation, but for some reason for years past the Council had opposed them in almost every proposal they had put forward for improving the undertaking.

Col. H. Wood, C.B., seconded the motion, and the report was adopted.

Direct Spanish Telegraph Co.

The report for the year 1902 shows that after providing for interest on, and redemption of, debentures, there is a balance to the credit of revenue of £11,182 3s. 10d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £6,182 3s. 10d., and the directors recommend the declaration of dividends for the year 1902 of 10 per cent. on the preference shares, and 4 per cent., free of income-tax, on the ordinary shares, amounting to £5,401 14s. 8d. Half of this amount was distributed on October 1st, 1902, as an interim dividend for the half-year ended June 30th, 1902. A balance of £780 9s. 2d. will remain, which the directors propose to transfer to the contingencies account.

The traffic receipts show an increase of £3,151 4s., as compared with the year 1901. The ordinary working expenses show an increase of £299 11s. 7d., as compared with the year 1901. On November 7th, 1902, the Marseilles—Barcelona cable became interrupted close to the landing place at Marseilles. The Eastern Telegraph Co.'s cable ship *Levant* effected the necessary repairs on November 22nd, the interruption of communication lasting 15 days. The cost of these repairs, amounting to £905 5s. 7d., has been charged to revenue. The Bilbao cable broke down at about 206 knots from the English end on December 17th, 1902. Owing to very bad weather in the Bay of Biscay, it was not possible to repair the cable until February 5th, 1903. The restoration was effected by the Eastern Telegraph Co.'s cable ship *John Pender*. On January 27th, 1903, the Marseilles—Barcelona cable was found to be again interrupted at 57 knots from Barcelona, and the repairs were successfully carried out by the French Government cable ship *Charente*, communication being restored on February 21st, 1903. The cost of these two repairs will appear in the current year's accounts. The general offices of the company were removed from Winchester House, Old Broad Street, to Electra House, Finsbury Pavement, on April 7th, 1902. The cost of such removal, and new fittings, &c., viz., £362 4s. 4d., has been charged to revenue. The meeting of the International Telegraph Conference has been fixed to take place in London on May 26th next. The directors much regret to report the resignation of Mr. Charles Gerhardi, who served this company with zeal and ability for 30 years. The board felt it right that his services should be recognised by the grant of a pension of £500 a year, which will be continued at the pleasure of the board, and they have no doubt that their action in this respect will receive the proprietors' approval. Mr. F. T. Preddle, who joined the company in 1873, has been appointed secretary.

Greenock and Port Glasgow Tramways Co.

The report for 1902 shows that the outlay on the electrical reconstruction during the year amounted to £51,656 15s. 5d., making the total expenditure to December 31st last £171,063 15s. 7d. During the year £30,000 debentures were issued as security for a loan. The total revenue was £26,429 15s. 6d., and the expenses £16,697 19s. 7d. The net profit was £9,731 15s. 11d., which added

CITY NOTES.

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When they had got to those very large units it was quite impossible to extend their station by driblets—they had to make a very large expenditure in one year instead of spending it on smaller engines over several years. The effect would be that at the end of this year they would have sufficient plant at Willesden, he hoped, to supply their needs without spending anything like a large amount of new capital for a period of at least three or four years. They must remember that although these large engines had been partly paid for they had not yet earned any dividend, so that the benefit from them would not come in this year; but he hoped it would be seen in next year's accounts. As regarded the £56,000 spent in Marylebone, that was almost entirely spent upon the conversion of the alternating into the continuous current, and that sum they were entitled to receive back from the Marylebone Borough Council. 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He thought they would consider that satisfactory, but he did not think that they had got to the bottom of their costs by any means, as they had every hope that when they got the large engines at work in Willesden, the cost of production would be still further reduced. One item which might seem a rather large one, was that of repairs, but that was chiefly due to the large number of small units that they were working from in their London station, but as they had sold part of this machinery, they would hope to benefit in the way of repairs in the future. Another notable increase was in rates. They had increased very largely, owing to the quinquennial re-valuation this past year, and he could not give them any hopes of a reduction in the future. So long as municipal bodies were seized with a craze for trading, so long would they have to pay more in rates, and where it would end goodness only knew. The Parliamentary charges were also high, but that was due to the action of the L.C.C., about which he would speak presently. They had put by the same sum for depreciation as last year—£10,000, and they considered that ample, especially taking into consideration the fact that they had no longer to put aside any depreciation for Marylebone, and that the L.C.C. was under the obligation of putting them up an entirely new station, with new machinery, in their Sardinia Street district. With the proposed addition, the depreciation fund would approximate to £100,000. The net result of the year was that after paying all charges, there was a balance of £73,873. £35,000 of that had already been distributed last October in the form of an interim dividend. That left £38,873 in hand, and the directors proposed that 7s. 6d. per share should be paid to complete the dividend, which would absorb £37,500, and make a total dividend for the year of 14s. 6d. per share, equal to a rate of 7¼ per cent. When they looked back and considered what their progress had been during the last few years—5 per cent., 6 per cent., 6½ per cent., and now 7¼ per cent., he thought they would be satisfied for the moment. There were two points about general policy and the general condition of the company to which he would like to refer. The first was as regarded the action of the L.C.C., who, year by year, had been putting them to considerable Parliamentary expenses in protecting their interests. As they knew, the company was working under the Electric Lighting Acts, 1882 and 1888, and it was on the strength of these Acts that the shareholders put their money into the concern. The L.C.C. last year and the year before, and again this year, were introducing a Bill into Parliament, which to his mind very seriously affected their interests. There were two special clauses in that Bill to which he wished to call their attention. The first was as regarded Willesden. When they went to Parliament six years ago for power to put up their Willesden station, the L.C.C., after being represented by the ablest counsel at the bar, did all they could to get Willesden put under the Electric Lighting Act. That meant that at the end of 35 years from that time the L.C.C. would have been able to buy Willesden at what he called old iron price. They fought that clause, and put before the Committee the fact that with such a clause it would be impossible to get the money for putting up the station. Now that it was put up it was one of the most magnificent stations in the world, and they had put over half a million of money into it. The L.C.C. had now actually introduced a clause into their Bill this year to put Willesden back again into the Electric Lighting Act, so that at the end of 29 years they would have to part with it for a mere song. Of course they were opposing that Bill. There was another clause in the Bill. Under the Electric Lighting Acts of 1882 and 1888 it was provided that at the end of their concession, which was in 1931, the Borough Councils or local authorities should have the right to buy so much of their works as was in their respective districts at what he would again call old iron prices. They who had given consideration to the question had come to the conclusion that long before their concession came to an end electric lighting works would be so gigantic that it would be absolutely impossible for any local body to buy the little bit in their own district. The L.C.C. wanted to take powers for the various local authorities to combine to buy the company out at the end of the term, and if they failed to do so the L.C.C. itself was to be able to buy them at old iron prices. That was almost as bad as trying to get Willesden, and they would strenuously oppose the Bill. The second reading came on on March 25th, and he hoped the shareholders would try and get their members in Parliament to oppose it. The other matter he would like to refer to was the sale of a portion of their undertaking to the Marylebone Borough Council. After repeated attempts to arrive at a settlement, they consented to sell under the Lands Clauses Act, and the matter was referred to arbitration, Mr. Russell, K.C., being appointed umpire. That arbitration had involved an immense amount of work on their officers and staff. It had necessitated 100 consultations, 33 days in Court, and over 11,000 questions had been put and answered. The result, of course, was as always happened in such cases—both parties were disappointed. The Borough Council thought they had had to pay too much, while they on their part thought they had got too little. He trusted, however, that the shareholders would make up their minds to be fairly satisfied with the award of £1,212,000. Let them remember that that did not include the amount they had spent in Marylebone since the notice to treat was given. They would be anxious to know when they would get the money; that they would get it there was not the slightest doubt. It must, however, be a matter of some little time before the financial arrangements were absolutely made, but he believed they might rely upon getting the whole of it well within the year. As regarded the question of getting in further capital to carry on the concern, of course that must depend to a certain extent upon when that money was received. When they got the money they would call the shareholders together and advise them as to what they wished done with it, and also as to whether it was desirable to alter the present capital condition of the company or not.

Sir J. Pender, Bart., seconded the motion.

Replying to the questions of several shareholders, the Chairman said that the debenture capital would require careful consideration as to how they were to protect their debenture holders when they had parted with a portion of the undertaking. As to the costs of the arbitration, they were borne by the Borough Council, but, of course, over and above the taxed costs, which they would get back, there must be certain other expenditure which they had incurred, and which would have to be paid by themselves. The whole cost of the arbitration would come to something like £60,000, only a very small fraction of which would fall upon the company. The amount of capital that they had put into Marylebone was just over half a million, and what they got was rather more than double, so he did not think they need complain. As regarded the loss of revenue they would suffer, that was rather difficult to tell. During the next two years certainly they would have very little loss, because they would have to supply the Council, and as to the future, it would, of course, all depend as to whether the Borough Council decided to put up their own station or to take their supply from the company, which would, of course, be much cheaper.

The report was then adopted.

Mr. Read proposed a vote of thanks to the chairman and directors and staff for the satisfactory manner in which they had carried through the arbitration, and gave notice that at the next meeting he would propose that those services be rewarded in a pecuniary manner.

The resolution was carried.

Oldham, Ashton and Hyde Electric Tramways, Ltd.

Mr. Garcke presided at the meeting held on Wednesday last week at Hamilton House. He said that the position of the undertaking was in every way satisfactory. The permanent way, rolling stock and other plant were being maintained in a condition of good repair and efficiency, and they were placing a sufficient sum to a sinking fund for depreciation and reserve in order to provide for all possible contingencies. After discharging all obligations, they were able to pay a satisfactory dividend of 8 per cent. on the ordinary shares for the year. The year had not been a thoroughly satisfactory one from a tramway traffic point of view. The summer was a

very unfavourable one as regarded the weather, and there was no factor that was so important as that bearing upon tramway receipts. Notwithstanding that, the traffic receipts had improved, and they had carried 5,240,000 passengers as against 4,900,000 in the preceding year, and the receipts had amounted to £27,780 as compared with £26,000. The average receipt per passenger had been 1·27d., the same as in the preceding year, but the average expenditure had been 1d. less, so that the percentage of expenditure to receipts had been slightly less. The trade of the district was now fairly satisfactory, and they looked forward to a year of satisfactory working; £2,000 was to be placed to depreciation and reserve fund, leaving a balance of £123 12s. 9d. to carry forward to the next account. The total capital expenditure was £135,409, but the issued capital was only £130,000. They proposed, therefore, to make an additional issue of £10,000, half in ordinary shares and half in preference, and they had offered them to the shareholders at the price of £22 10s. for two shares, one of each class, and it was indicative of the satisfaction the directors felt in regard to the position of the company, that, although the list was not yet closed, they had already received applications in excess of the number to be placed to the extent of about 60 per cent., and he expected that before the list was closed the shares would have been applied for twice over. The additional capital was required for the purpose of the extension which they had carried out, and for providing additional rolling stock. They would probably notice in the accounts a figure of £803 17s. 11d., which was the balance of the cost they had incurred in opposing the application for powers by adjoining local authorities. They were not successful in their opposition, but the expenditure was not altogether thrown away, as it resulted in their negotiating with the Hyde Corporation, the Stockport Corporation and the Romiley authorities for a lease for an extension of the tramways beyond Hyde, and for running powers up to the boundary of Stockport. There was an expenditure of £2,187, which had been on account of the construction of the extension lines, which had been leased to them by the Hyde Corporation. That expenditure was repayable to them by the Hyde Corporation, and as a matter of fact, a large portion of it had been paid since the closing of the accounts. At the time of the formation of that company, they were all alone in the district working electric tramways, but such had been the example set by the company of the good work that could be done by electric traction, that they were now practically surrounded by electrical tramways. They had not got physical junctions with the adjoining tramways, as their neighbours were too jealous to recognise the advantage that would be gained by such a connection. However, their passengers were able, by changing cars, to go throughout the district right up to Manchester and Stockport and various other places. He moved the adoption of the report, which Mr. Atherley Jones, K.C., M.P., seconded.

The report was adopted.

Hove Electric Lighting Co.

The eleventh annual general meeting of the shareholders of this company was held on Thursday of last week at Salisbury House, London Wall, Col. A. J. Filgate, the chairman, presiding.

The Chairman, in proposing the adoption of the report, said he thought he was justified in congratulating the shareholders on the results obtained in working the undertaking, and the progress of the business in the past year. The capital expenditure during the year amounted to £17,304, bringing the total expenditure on capital account up to £127,103. The bulk of the outlay last year was in connection with the new generating station which was now nearly completed, and which would be in full working order to meet the autumn and winter load. The total cost of the new station and its equipment, together with the necessary mains, would amount to about £35,000. That was a large figure, but the matter had received very careful attention, and they believed the investment would prove remunerative. The remaining capital expenditure, consisted of £3,321 on additional mains and strengthening existing mains and house connections, and changing over customers on the 110 volts to the 220 volts. They had increased the length of their mains by 965 yards, and their total length of mains now measured 17 miles 845 yards. To meet the capital outlay during the year they issued the 255 shares remaining out of the last issue at £7 10s. and £7 15s. per share, and called up the whole of the money due on that issue. They also placed £11,370 of additional 4 per cent. debenture stock. They had this year offered the debenture issue to the shareholders, and had placed a further sum of £6,730, and later on they proposed to make a further issue. The number of houses on the system on December 31st last was 1,040—an increase during the year of 119 houses. At the close of the year, the lamps and motors on the system reached the equivalent of 69,924, 8-c.p. lamps, against 61,366 at the end of 1901—an increase of 8,558 8-c.p. lamps; and the units sold to customers during the year amounted to 735,316 compared with 629,427 in 1901, an increase of 105,889 units, or nearly 17 per cent. The gross revenue of the year amounted to £17,562 compared with £15,518 in 1901, an increase of £2,044. The expenditure had amounted to £7,519 against £7,236, an increase of £283. Allowing, however, for the full outlay on maintenance and repairs during the two years, the actual expenditure had been £7,803 in 1902 and £7,423 in 1901. They were fortunate in obtaining their coal on more satisfactory terms, and notwithstanding their larger output the coal bill was only £21 in excess of the previous year. The net revenue of the year amounted to £10,043 compared with £8,282 in 1901. With the balance brought forward and interest on deposits, the sum they had to deal with in the profit and loss account was £10,156. From that had to be deducted interest on debentures and loans £1,314, and the interim dividend paid in October of £2,203. That left a balance of £6,638, and they recommended that £2,500 should be placed to the reserve account; £500 to the maintenance reserve account; and to declare a final dividend at the rate of 10 per cent. per annum for the half-year on the paid-up capital, making with the interim dividend 8½ per cent. for the year. They had already placed the premiums realised on the shares placed last year—£676—to the reserve fund account, and with the addition now proposed that fund would stand at £24,326. He would like to draw attention to the steady increase in the business. The number of units delivered to customers in 1900 was 94,000 in excess of the delivery in the previous year; 1901 showed an increase of 90,000 units over 1900, and the units consumed in 1902 were 105,000 in excess of the consumption in 1901. He was glad to say the progress was continuing, as in the first 10 weeks of this year the units delivered showed an increase of 22,213 compared with the same period of 1902. 1,029 additional lamps had already been connected this year up to date, and 1,339 more were waiting. Their average receipts for current delivered to customers came to a little under 5½d. a unit, and their average receipts per 8-c.p. lamp to under 4s. 10d. a year. With the reduction in charges the revenue per lamp had decreased, and their profits were only secured by close attention and strict economy on the part of the staff. Although they were incurring heavy additional capital outlay, they believed it to be fully justified, and hereafter while reducing the charge for electricity they hoped not only to maintain the present dividend, but before long to increase it. They had thought it desirable to call attention in the report to the action they had found it necessary to take regarding the change over from 110 volts to 220 volts pressure. They had never been able to understand why the Hove Corporation had assumed the attitude they had in the matter. They had frequently inquired the cause of their objections, but had never been able to elicit any explanation. They expected that the Corporation would have said something tangible before the Board of Trade inquiry, which they informed them they were most anxious to have, but their contention there was limited to a statement that the proposed change was not in accordance with the terms of the agreement transferring the Corporation's rights under the order to the company, and that the change was not desirable. How they could reconcile that position with their action in allowing them in 1898 to supply all new customers at a pressure of 220 volts, and, further, in drawing up their own scheme for the parish of Aldrington when they notified their intention of installing the current in that parish at a pressure of 220 volts, it was difficult to understand. They had not yet heard officially that their application to be allowed to change over the consumers on 110 volts to 220 volts had been granted, but they had no reason to doubt that would be the case. They were most anxious to work in harmony with the Corporation, but for some reason for years past the Council had opposed them in almost every proposal they had put forward for improving the undertaking.

Col. H. Wood, C.B., seconded the motion, and the report was adopted.

Direct Spanish Telegraph Co.

The report for the year 1902 shows that after providing for interest on, and redemption of, debentures, there is a balance to the credit of revenue of £11,182 3s. 10d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £6,182 3s. 10d., and the directors recommend the declaration of dividends for the year 1902 of 10 per cent. on the preference shares, and 4 per cent., free of income-tax, on the ordinary shares, amounting to £5,401 14s. 8d. Half of this amount was distributed on October 1st, 1902, as an interim dividend for the half-year ended June 30th, 1902. A balance of £780 9s. 2d. will remain, which the directors propose to transfer to the contingencies account.

The traffic receipts show an increase of £3,151 4s., as compared with the year 1901. The ordinary working expenses show an increase of £299 11s. 7d., as compared with the year 1901. On November 7th, 1902, the Marseilles—Barcelona cable became interrupted close to the landing place at Marseilles. The Eastern Telegraph Co.'s cable ship *Levant* effected the necessary repairs on November 22nd, the interruption of communication lasting 15 days. The cost of these repairs, amounting to £905 5s. 7d., has been charged to revenue. The Bilbao cable broke down at about 203 knots from the English end on December 17th, 1902. Owing to very bad weather in the Bay of Biscay, it was not possible to repair the cable until February 5th, 1903. The restoration was effected by the Eastern Telegraph Co.'s cable ship *John Pender*. On January 27th, 1903, the Marseilles—Barcelona cable was found to be again interrupted at 57 knots from Barcelona, and the repairs were successfully carried out by the French Government cable ship *Charente*, communication being restored on February 21st, 1903. The cost of these two repairs will appear in the current year's accounts. The general offices of the company were removed from Winchester House, Old Broad Street, to Electra House, Finsbury Pavement, on April 7th, 1902. The cost of such removal, and new fittings, &c., viz., £362 4s. 4d., has been charged to revenue. The meeting of the International Telegraph Conference has been fixed to take place in London on May 26th next. The directors much regret to report the resignation of Mr. Charles Gerhardi, who served this company with zeal and ability for 30 years. The board felt it right that his services should be recognised by the grant of a pension of £500 a year, which will be continued at the pleasure of the board, and they have no doubt that their action in this respect will receive the proprietors' approval. Mr. F. T. Preddle, who joined the company in 1873, has been appointed secretary.

Greenock and Port Glasgow Tramways Co.

The report for 1902 shows that the outlay on the electrical reconstruction during the year amounted to £51,656 15s. 5d., making the total expenditure to December 31st last £171,063 15s. 7d. During the year £30,000 debentures were issued as security for a loan. The total revenue was £26,429 15s. 6d., and the expenses £16,697 19s. 7d. The net profit was £9,731 15s. 11d., which added

to the amount brought forward makes £10,461 17s. 10d., which will be applied as follows:—Depreciation and renewals account, £1,500; reserve (sinking) fund, £1,780; dividend, 5 per cent. per annum on preference shares, £304 11s. 3d.; 6 per cent. per annum on the ordinary shares, £2 890 9s. 4d.; balance carried forward, £3,986 17s. 3d. = £10,461 17s. 10d. With reference to the £1,780 set aside in the proposed allocation of profits for the service of the sinking fund, the directors propose to set aside such a sum annually out of the profits as will provide for any shrinkage in the capital value in the event of compulsory sale. During the year an order entitled "The Greenock and Port Glasgow Tramways (extension) Order, 1902" was obtained, authorising the company to increase the share capital from £120,000 to £185,000, and to raise in debentures a further sum of £21,500 in addition to the amounts authorised by the previous Acts. It also empowers the company to construct and work a short extension about 1 furlong from the Port Glasgow terminus, and to run motor-cars and omnibuses in connection with the tramways. The extension will be proceeded with at the end of March. A difference of opinion has arisen between the Greenock Corporation and the company, in connection with the supply by the former of electrical energy for working the tramways. The points in dispute have been referred to the Board of Trade for settlement by arbitration.

Miles open—	
Route miles	7·585
Single line	·77
Double line	6 815
Number of passengers carried..	5,330,105
Average receipts per passenger	1·16d.
Average expenditure per passenger	·74d.
Proportion of expenses to receipts	64 p. c.
Number of cars in stock	90

Winchester Electric Light and Power Co.

Mr. T. F. Kirby presided at the annual meeting of this company last week. He moved the adoption of the report for 1902, which showed that 7,441 8-c.p. lamps had been added, making a total of 28,256 lamps. There was an available net balance of £3,711, and, after paying debenture interest, £2,330 was available for a 5 per cent. dividend on the ordinary shares, and £794 was carried to reserve and renewal fund, £128 being carried forward. One thousand ordinary shares have been issued at par and £8,100 debentures at a premium. Mr. Kirby said that the report was satisfactory. The net revenue was £3,711 as against £2,713 in 1901. During the year just past there had been an increase of £1,041 in the sales of current and the rent of motors. The cost of coal had been £1,185, an increase on the previous year, when the cost had been £1,087. This increase was, of course, due to a corresponding increase in business, and he thought great economy had been shown. The loan capital was £28,000 and the share capital £30,000. They still had power remaining to issue a further £17,000 loan capital and £20,000 ordinary, which might be issued as ordinary or preference shares.

Davis & Timmins.

Sir Henry Mance presided at the meeting of this company on 12th inst., and in moving the adoption of the report, which we published last week, said that it was satisfactory to all the shareholders. The profits had been about the same as in the previous year, notwithstanding that there had been a good deal of depression of trade which naturally brought about keener competition and a cutting of prices. After going through some of the figures in the accounts and showing the increases and decreases, Sir Henry referred to the question of the trouble they had had with the assessment authorities. The manner in which it was attempted to levy increased rates and taxes was arbitrary and likely to give rise to a feeling of insecurity. The sooner the promised legislation took place the better, for industrial and other undertakings were being put to unnecessary expense by being compelled to appeal against the unreasonable decisions of the local authorities. The directors had increased the allowance for depreciation on machinery, &c., by £360.

The report was adopted.

Baker Street and Waterloo Railway Co.

Mr. Theodore J. Hare presided on Monday last at the meeting of this company held at Hamilton House. In moving the adoption of the report, of which an abstract appeared last week, he said that the receipts on account of share capital during the half-year had been £202,940, and the expenditure £96,713. The total expenditure to date had been £1,142,903. The progress made with the construction of the works had not been quite so rapid as they had wished, but it had been chiefly owing to difficulties with the landowners—difficulties which had now been overcome. The estimated expenditure during the current half-year was £185,000; only 20 per cent. of the whole length of the tunnelling between Baker Street and Waterloo remained to be completed, and it was expected that both tunnels would be finished in about five months. Work at the stations was being pushed on as rapidly as possible. With regard to the extension from Waterloo to the Elephant and Castle, the contract had been let to Messrs. Mowlem & Co. The speaker referred to the Royal Commission which is now sitting on the London traffic problem; he had no doubt that the results of the Commission's labours would be the production of a scheme which would solve the difficult problem for many years to come. Most of the Bills for new lines had been deferred, but this company's Bill, as it did not provide for any extension, was to proceed in the usual course.

Sir Algernon West seconded, and it was carried.

After other routine business had been transacted, a Wharncliffe meeting was held, at which the solicitor went through the clauses in the company's new Bill. The chairman said that the directors had decided to drop the clauses for amalgamation, and to instead ask for powers for the Underground Electric Railways Co., Ltd., to work the undertaking and guarantee, after the payment of all working expenses, a dividend of 4 per cent. to the Baker Street and Waterloo shareholders. This arrangement, he said, would be carried through either by means of a lease or working arrangement in perpetuity. The precise terms of the document were under consideration.

The resolution was passed.

Northern Counties Electricity Supply Co.

The directors' report for 1902 says that 3s. per share remains uncalled on 96,000 £1 shares. The amount expended during the year was £66,048 10s. 1d., making a total capital expenditure on works account of £88,179 1s. 6d. The stations supplying Blyth, Spennymoor and Alnwick were in running order at the end of the year, and the capital expenditure per kilowatt capacity compares favourably with similar undertakings. The Hebburn station was not finished at the end of the year, but is expected to be in working operation at an early date.

Orders were obtained by the company for the areas of Amble, Ashington Bedlingtonshire, Earsdon, Seghill, Morpeth and Newbiggin, in the County of Northumberland, and Leadgate and Stanley in the County of Durham, so that the company now holds, including areas previously secured, the right of electric supply in important colliery centres of Northumberland and Durham. A contract for the company to work the order held by the Hartlepool Corporation has been also arranged. In the Northumberland Electric Tramways Act, 1902, the company obtained without opposition all the sections applied for with the exception of one which is still in abeyance. At Blyth, Spennymoor and Alnwick the obtaining and connecting of consumers have been actively pursued. The connections made at the end of the year amounted to 894 consumers, with an equivalent of 12,658 lamps of 8 c.p. The directors consider the progress made in this direction has been satisfactory, and in addition to the lighting connections that are being made from time to time, important power consumers have been obtained and others are in prospect. As it would be misleading to show a revenue account for the broken periods of the past year, the working charges to December 31st last have been debited to preliminary expenses account and the sale of current credited. The revenue account will begin as from January 1st, 1903, with three stations completed. A contract having been entered into for working the provisional order held by the Hartlepool Corporation, the erection of a station there will shortly be commenced. Arrangements are being made to erect a station at Thirsk. The district of Felling-on-Tyne is also being dealt with and will probably be worked in conjunction with Hebburn, and arrangements for Whitley and Monkseaton and other places are being made. The directors have before them the supply of certain areas, in the colliery districts of Northumberland and Durham, which they hope to arrange in a way that will save a large capital outlay and materially add to the earnings of the company. In order to carry out these works, additional capital is required and the directors have decided to make a further issue of shares. The amount of the new issue has been fixed at 50,000 shares of £1 each, which will shortly be offered at *par* to the present shareholders *pro rata* as near as may be to their holdings, each shareholder being entitled to one new share for every complete number of two shares at present held. The directors hope that any issue of shares, beyond those now about to be made, may, considering the prospects of the company and the present market price, be issued at a premium.

British Insulated and Helsby Cables, Ltd.

The directors' report for the year ended December 31st, 1902, shows a profit of £127,696 1s. 4d., to which is added balance brought forward, £2,423 16s. 5d. = ... £130,119 17 9

From this has to be deducted directors' and debenture trustees' fees, and remuneration to works committee, *less* directors' fees receivable from other companies..	£2,750	15	4	
Interest on debenture stock	16,400	17	4	
Depreciation on buildings, plant, machinery, &c. ..	17,500	0	0	
Transfer to special reserve account	10,000	0	0	
Dividend on preference shares to December 31, 1902	30,000	0	0	
Interim dividend on ordinary shares to June 30, 1902	20,000	0	0	
				96,651 12 8
Leaving available for dividend a balance of				£33,468 5 1
The directors recommend the payment of a further dividend of 6 per cent. on the ordinary shares..				30,000 0 0
Making, with the interim dividend already paid, a total of 10 per cent. for the year ended December 31st, 1902.				
Carrying forward to next account a balance of..				£3,468 5 1

The negotiations referred to in the last year's report for a union of interests with the Telegraph Manufacturing Co., Ltd., of Helsby, have been completed, the shareholders of that company being allotted 30,000 ordinary shares and 20,000 preference shares at £5 each as the purchase price, and as arranged, three of the directors of the Telegraph Manufacturing Co, Ltd., joined the board of this company. Upon the completion of the amalgamation, the directors came to the conclusion that a general manager should be appointed, who would have a supervising control of the entire interests of the company, and they were successful in securing the services of Mr. D. Sinclair, who has had many years' experience of electrical business as engineer-in-chief to the National Telephone Co., Ltd. Mr. Sinclair entered upon his duties in August last, and the directors feel amply justified in the choice they made. The directors have transferred from the general reserve account to a special reserve account the sum of £100,000, to which £10,000 has been added out of the year's profit, making a total of £110,000, partly with the view of meeting any loss which might arise on investments, and also with the object of writing off the expenses of the preference share and debenture issues, cost of amalgamation, &c. In addition to the preference and ordinary shares issued in satisfaction of the purchase of the Telegraph Manufac-

turing Co.'s business, a further £50,000 in preference shares, and £250,000 in debenture stock were offered to the public, both issues being largely over-applied for. The provision of this additional capital has enabled the directors to extend the company's manufacturing facilities, and to bring into working condition some of the most important of the company's electrical undertakings.

Bournemouth and Poole Electricity Supply Co.

The directors' report for 1902 states that the capital expenditure incurred during the year on the Bournemouth, Poole, Christchurch, and Pokesdown orders amounted to £34,916 14s. 5d., making the total expenditure in respect of these orders up to December 31st last £231,456 8s. 8d.

The balance from revenue account, together with the balance brought forward from last year, amounted to £19,499 11s. 8d., from which must be deducted interest charges, reserve for depreciation and redemption funds, leaving the sum of £11,741 8s. 3d. to the credit of net revenue account, as against £8,912 11s. 11d. for 1901. Out of this sum the dividends on the 4½ per cent. and on the 6 per cent. preference shares of the company have been paid, and the directors now recommend the payment of a dividend on the ordinary shares of the company at the rate of 8 per cent., less income-tax, for the year ended December 31st, 1902. These payments will absorb £10,351 8s. 11d., and leave a balance of £1,389 19s. 4d. to be carried forward. Special mains have been laid for power purposes, and a supply of continuous current therefrom has been available since the commencement of last year. The work of extending the company's mains to Poole and Parkstone, commenced in 1901, has been completed. A generating station at Christchurch is now in course of erection, and a supply therefrom, for both lighting and power, will be available shortly. The Bournemouth Corporation and the company applied for a provisional order for Pokesdown in the last session of Parliament. The Corporation's application was refused, while that of the company was granted by the Board of Trade, and confirmed by Parliament, and the company's mains are now being extended for the purposes of supply in that district. The equivalent of 79,309 8-c.p. lamps were connected to the company's mains at December 31st last, showing an increase equivalent to 13,247 8-c.p. lamps connected for this year. The lamps applied for show an increase of 13,343 8-c.p. for the year, as against 12,378 for the preceding year. The progress of the Richmond (Surrey) Electric Light and Power Co., Ltd., continues to be satisfactory. The directors of that company have declared a dividend upon its ordinary shares at the rate of 7 per cent. per annum in respect of the year ended December 31st last, as against 6 per cent. for the previous year.

County of London and Brush Provincial Electric Lighting Co.

The directors' report for 1902 says that the capital expended during the year in respect of the company's London districts, amounted to £143,857 19s. 11d., making the total expenditure on account of those districts, up to December 31st last, £1,166,366 13s. 11d.

Revenue.—Balance from last account, after payment of the final dividends on the preference shares and the ordinary shares of the company for the half-year ended December 31st, 1901, less income-tax	£4,036	9	8
Balance from Revenue Account No. II., after deducting generation and distribution costs, &c., and payment of directors' fees, rent, rates, taxes, general establishment and other charges, wages and proportion of salaries	64,265	2	1
Making a total available revenue for the year 1902 of	£68,301	11	9
From which should be deducted the following items :—			
(a) Interest on debenture stock, including interest on instalments paid in advance, and interest on temporary loans, less income-tax	£22,399	16	10
(b) Interim dividend on 20,000 6 per cent. preference shares for half-year ended June 30th, 1902, and on a further 10,000 6 per cent. preference shares for the same period from the due dates of instalments, less income-tax	8,010	13	1
(c) Interim dividend on 40,000 ordinary shares at 4 per cent. per annum for half-year ended June 30th, 1902, less income-tax ..	7,516	13	4
(d) Amount written off preliminary expenses account	1,130	11	5
(e) Amount carried to contingency account	250	0	0
(f) Amount carried to reserve for depreciation, repairs, renewals, &c.	8,000	0	0
	£47,407	14	8
Leaving for further distribution	£20,893	17	1

The directors now recommend that further dividends be paid on the preference and ordinary shares, making 6 per cent. on the preference and 4 per cent. per annum on the ordinary shares. This will absorb £15,937 10s., and leave a balance of £4,956 7s. 1d. to be carried forward. The several capital and revenue accounts hitherto shown separately under their respective orders have this year, with the consent of the Board of Trade auditor, been consolidated into one set of accounts for the purpose of simplification. The company's interest in the Dover Electricity Supply Co., Ltd., has been disposed of, and the profit realised therefrom appears in the revenue account for the period under review. The Borough Council for Camberwell applied to Parliament last year for competing powers with the company, but withdrew its application upon the Board of Trade intimating that an order would be granted only on condition that the Borough Council purchased the company's undertaking within the area of supply under the terms of the Camberwell Order, 1896. The Borough Councils for Bermondsey and Southwark also applied for competing powers with the company in respect of St. Olave, Bermondsey, and St. George-the-Martyr, Southwark. The Board of Trade, however, after hearing evidence, refused to grant these orders. The arbitrator appointed by the Board of Trade under the terms of the Stepney Order, 1900, awarded the company the total sum of £7,393 5s. 4d., including part costs, as compensation in respect of the County of London (East) Electric Lighting Order, 1897. The sum received in respect of costs has been credited to the proper accounts in the company's books, and the balance remaining has been placed to the credit of reserve for depreciation, repairs and renewals account. In order to provide further funds, as necessity arises, for the development of the company's business, the directors propose to increase the share capital of the company from £800,000 to £1,600,000 by the creation of a further 40,000 preference shares of £10 each, and a further 40,000 ordinary shares of £10 each. The directors also propose to increase the borrowing powers from £400,000 to £800,000. The necessary resolutions embodying the above proposals will be submitted to the shareholders for their approval at the meeting to be held on 23rd inst.

The profits derived from the company's London stations for 1902 amounted to £61,698 16s. 6d., against £50,503 19s. 4d. for 1901, being an increase of 22 per cent. for the year, while the generation and distribution costs and working expenses show an increase of only 3·15 per cent. over the figures of 1901. The total applications received at December 31st last amounted to the equivalent of 416,292 8-c.p. lamps, being an increase of 90,314, or 28 per cent. for the year. Included in these figures are 396 users of motors aggregating 4,424 h.p., showing an increase of 1,639 h.p. for 1902. The total units sold were 4,868,285, as against 4,351,105 for the previous year. To meet the growth of the company's business additional generating plant has been erected during the past year at the City Road station, and further plant is now on order. At the company's Wandsworth station the buildings are being extended for the accommodation of additional plant which will be erected there during the current year. In view of the development of the company's business in the southern districts, the directors have purchased a site for a generating station in Camberwell, and are thus prepared for any future developments that may arise. The supply of continuous current was commenced in St. Olave last year, and the prospects in this district are most encouraging. In order to meet the requirements of all classes of consumers in the company's area, the directors have introduced a scheme of wiring premises on the rental system, and have also adopted prepayment meters for use in small premises. The directors of the Bournemouth and Poole Electricity Supply Co., Ltd., have declared a dividend on the ordinary shares of the company, at the rate of 8 per cent., as against 7 per cent. for the previous year. The Scottish House-to-House Electricity Co., Ltd., has made substantial progress during the year. The remodelling of the Coatbridge station and the conversion from alternating to continuous current is now complete, and a supply from that station to the adjoining Burgh of Airdrie is available. The company has disposed of its interest in the Airdrie and Coatbridge Tramways Co. on a satisfactory basis, and terms have been agreed between the respective companies for supply of the necessary power for working the tramways when completed.

Poole and District Electric Traction Co.

Mr. Garcke presided at the annual meeting of this company held at Donington House on Tuesday. He said that the shareholders were to be congratulated upon the result of the working and upon the position of the company generally. In comparing the profit and loss account with that of the previous year, it must be borne in mind that the present account was for a full year, whereas the preceding one was for only nine months. The lines were opened in April, 1901, and they paid a dividend at the rate of 6 per cent. for the year, but for the past year they were able to pay at 8 per cent. and place to depreciation and reserve £1,000 as in the preceding year, and to carry forward to next year £959. The result had been satisfactory, notwithstanding that during the year they had experienced very unfavourable weather from a tramway point of view. The item of repairs and maintenance appeared rather heavy as compared with the expenditure under that head in the preceding year. That was largely due to the heavier amounts they had had to spend on repairs of permanent way rendered necessary by the very heavy vehicular traffic which had passed over the route while the Corporation lines were constructing. The administration and general expenses showed increases largely because of increased rates and the item of income-tax now introduced into the accounts. On capital account they had expended £8,904 during the year, mainly upon six additional cars and electrical equipments which cost over £6,000, and £2,110 had been spent on Parliamentary and preliminary expenses. The company's relations with the Bournemouth Corporation were antagonistic, and at the same time friendly. They were still at litigation, though the appeal to the House of Lords had been suspended by mutual consent pending the application to Parliament by the Bournemouth Corporation for powers to purchase this company's undertaking. In the course of the next few months they would know more as to what was to happen in regard to this undertaking in the future.

The report was adopted, and the retiring directors and auditors re-elected.

Oxford Electric Co.

Sir Henry Mance presided on 6th inst. at this company's meeting, and moved the adoption of the report, which appeared in our issue of February 27th. He said that the revenue had greatly increased, and the working costs had been reduced from 3·12d. to 2·44d. After paying interest and some other items, there was a net profit of £6,179; £2,250 had been placed to the reserve and renewal of plant account, bringing that fund up to £4,500. After paying a 5½ per cent. dividend on the capital, £276 was carried forward. At the end of the year there were 46,000 lamps (8 c.p. equivalent) connected, and 50 per cent. were in circuit at one time. After detailing the various expenditures on capital account during the year, for new land, buildings, coal accommodation, boiler machinery, &c., Sir Henry said that the number of consumers had increased to 760 from 673 in 1901, the new lamps added being 5,592. Expenditure on hire-purchase installations (£989) brought on the equivalent of 1,300 lamps. The share capital had been increased by 1,926 shares to £70,000. The current year's capital expenditure would not be less than that of last year, and an issue of shares would be made. They had ordered a 375-kw. fast speed engine and dynamo to suffice for the next two years' additions. The efficiency for the year had been 2 per cent. better than for the previous year; coal was cheaper, and 6·1 lbs. were used per unit instead of 6·8 lbs. The decreased cost of distribution was mainly due to the reduced mains' maintenance charges. They had relaid the old cables on the solid system, and this would give them another 50 years of life. The revenue from current sold during

the year was £13,965, as against £11,938 for the previous year. The Corporation had renewed the public lighting contract for the next five years. The directors saw no reason to regret the adoption of the continuous current. As the low tension mains gradually stretched out from the centre of the city toward the generating station they might find it convenient to supply a portion of the area direct from the generators, and it was in the minds of the directors to use higher voltage in order to reach the sub-stations economically as fresh extensions in the north or east of Oxford became necessary.

The report was adopted.

Edwards Air Pump Syndicate.

The report for 1902 states that royalties amounting to £4,792 were received, as compared with £4,734 for 1901, while the ordinary expenditure was £2,565, a slight decrease on the previous year. The number of pumps for electrical and other land installations shows a satisfactory increase, and for the first time has exceeded the number of marine pumps, the former representing 52 per cent. and the latter 48 per cent. of the total number of pumps booked. The directors propose applying £1,000 to sinking fund account for redemption of cost of acquiring patents to pay a dividend of 6 per cent. on the called-up capital £1,272, and to carry forward the sum of £166.

Folkestone Electricity Supply Co.

The report for 1902 states that there is a profit on the revenue account of £5,177. The directors recommend the payment of a dividend at the rate of 6 per cent. for the half-year (making 5 per cent. for the year), which will require £1,500, and the placing of £500 to the reserve fund or a depreciation fund, thus leaving a balance of £203 to carry forward. The directors have entered into an agreement with the local authority at Hythe for the working of their provisional order, and they are concluding negotiations with the District Council of Sandgate for the working of the Sandgate order. To provide the cost of the outlay in connection with the supply of these two districts and for further extensions in Folkestone, and to pay off the bank overdraft, additional capital has been created, in the shape of 10,000 5 per cent. preference shares of £5 each. A first issue of 5,000 of these shares was offered in January last to the shareholders and debenture stockholders of the company, and was over-subscribed.

Charing Cross and Strand Electric Supply Corporation.—An extraordinary general meeting will be held on 26th inst. to pass resolutions increasing the capital by the creation and issue of 40,000 City Undertaking £5 preference shares at 4½ per cent. per annum.

Prospectus.—The Devonport and District Tramways Co. has been before the public this week inviting applications for an issue of £14,700 4 per cent. debentures at par, to enable it to discharge its liabilities on capital account. The list closed on Wednesday.

Melton Mowbray Electric Light Co.—At the annual meeting last week, Mr. W. J. New presiding, it was reported that the number of lamps connected have increased from 4,111 to 8,520 during the past year, and the number of consumers had been just doubled. A dividend of 2½ per cent. per annum was declared. In order to provide for new machinery and further extensions it was decided to issue 3,000 new shares of £5 each, and to authorise the directors to borrow sums of money not exceeding £10,000.

United Alkali Co.—The report for 1902 shows a net profit of £242,795. Adding amount brought forward from 1901, £38,106, there is a total of £280,902, which the directors propose shall be apportioned as follows:—A second interim dividend on preference shares at 7s. per share, transfer to debenture redemption account £15,000, leaving to be carried forward £80,290. During the year certain patent rights have been assigned to the Power-Gas Corporation, Ltd., payment for which has been made by the allotment to this company of shares to the nominal value of £28,569.

Buenos Ayres Grand National Tramways Co.—An extraordinary meeting of this company was held last week in London, when resolutions for entering into a provisional agreement with other Buenos Ayres tramways companies, and authorising the directors to raise £700,000 for such purpose, were passed. The agreement provides for electrification, which will increase the receipts per mile by 50 per cent. The working expenses are at present 80 per cent., and by electrification it is expected to reduce this figure to 55 or 56 per cent. The joint system consists of 82 miles of line.

Brush Electrical Engineering Co.—The directors have decided, subject to audit, to recommend payment of the full dividend of 6 per cent. to the preference shareholders for the year ended December 31st, 1902, leaving a sum of about £1,187 to be carried forward, after placing £6,500 to depreciation reserve fund and £5,000 to general reserve fund.

STOCKS AND SHARES.

Wednesday Evening.

The Stock Exchange is taking more interest in its domestic affairs than it is in regard to business, for the latter continues to be as slack as ever in most of the markets. Money remains fairly expensive, and this is a factor that makes its influence felt more hardly every day upon Consols and similar securities. Out of the multitude of reasons placarded by insistent newspapers for the fall in Consols, the most obvious of all is that there are far more sellers than buyers, and, this being the case, investment departments are mostly dull along with the Funds. Alluring though the prospect be, we will refrain from the temptation of expanding explanations for the weakness; suffice it to say, that the immediate outlook does not favour any substantial recovery.

Home Railway stocks incline to be easier, the slender amount of public interest aroused a few weeks ago in this section failing to be maintained. But electric railway stocks are steady. Waterloo and City can hardly be bought under 99, and after dipping a fraction, City and South London recovered at 76, while Central Londons are virtually unchanged. Nothing appears to have been done up to the present in the way of meeting the ventilation problem on the Twopenny Tube. District and Metropolitan are 40¾ and 88 respectively, East London 6¼, and Furness 68½. Great Northern and City Preferred shares have crept into some prominence, and are changing hands at 8¼ and its neighbouring fractions. Of the gilt-edged stocks, Central London 4 per cent. Debenture was sold the other day by a broker at 117. The three City and South London Preference issues are quoted 131½, 129½ and 126½, in the order at which they were offered.

Reference has been so frequently made in these columns to the coming of a Yorkshire Electric Power Co., that readers will have experienced no surprise at having seen the prospectus advertised this week. No premium has been, so far, established upon the shares of the undertaking. We understand that the reception accorded to the Yorkshire Power Co. will govern in no small degree the issue of a very similar concern next week. There may be even more than one if the Yorkshire is well subscribed. Another new emission on the carpet takes the shape of shares in an electrical engineering firm of considerable importance.

Both the British Thomson-Houston and the Callender's Cable Companies are mentioned in connection with the Yorkshire Electric Power Callender's shares; stand at 14, and the 4½ per cent. Debenture stock of the British Thomson-Houston is officially quoted at 104.

While upon the topic of new issues, it may be mentioned that high authority contradicts the rumour which would saddle the County of London and Brush with a fresh offer of Debenture stock almost immediately. It would appear that although powers may be taken to increase the amount of Debenture stock, no present issue is contemplated. The County report is open to criticism in regard to the money which the company has invested in other ventures; the statistics are not differentiated sufficiently for the student to see exactly how things stand in this respect, and it is not a small point. County Ordinary shares are 9, the Preference 12½, and the Debenture stock about 110.

Kensingtons are a good market at 11, and there is a good deal being done in the shares. South Londons have been bought at 3⅞; but it is open to grave question as to whether the sum applied to depreciation can be called anything like adequate. Smithfields also continue in request. Brush are steady, with little business passing, and the dividend on the Preference shares has helped the price a fraction. Metropolitans have stiffened, the meeting being regarded as satisfactory, and the chairman's speech as distinctly diplomatic. Westminsters are in demand, and the price is 12½ to 13, the new shares being 6½. The Folkestone dividend, making 5 per cent. for the year, has left the shares unchanged at 6¼ middle.

Telegraph stocks and shares are, in Stock Exchange parlance, playing piano, pending further developments in the world of wireless wonders. After being very weak, the Anglo-American group hardened up sharply, while in the Far Eastern division business has been almost at a standstill. One or two of the best class stocks have come into request. Western Telegraph Debenture stock is wanted at 98, to give one example. Telephone varieties are fairly active, especially National Preferred, which now stands about a point below par, the Deferred being 72½. The third Preference shares keep about at 5½. Chili Telephones are unchanged.

In the traction market, the general tendency is good. London United Tramways Preference are up to 11¾, and amongst foreign descriptions several rises have to be chronicled in the Buenos Ayres and Belgrano list. The Ordinary shares are 2⅞, and the two Preference 5½. British Columbia Electric Railway Deferred stock has been done at 69½ this week, and Anglo-Argentine trams at 4⅞. British Electric Tractions are a firm market, and this section, as a whole, looks like going better.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Mar. 11th.	Closing Quotations Mar. 18th.	Business done week ended Mar. 18th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3½	2¼— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
798,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	48 — 51	49 — 52	..	..
3,105,580	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 96	92 — 94	92½	91
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8½	8¼— 8½	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4 — 4½	4½	..
19,333,300$	Commercial Cable	$100	8 %	8 %	..	160 —170	160 —170	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	91	90
16,000	Cuba Telegraph	10	4½%	4 %	..	6½— 7½	6½— 7½	6¾	..
6,000	Do. 10 % Pref.	10	..	..	..	13½— 14½	13½— 14½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9 — 10	9 — 10	..	..
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	122 —127	121 —126	124½	102
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	86 — 89	86 — 89	87½	86½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	107	..
900,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	11½— 12½	11½— 12½	12	11½
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —105	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	98 —101	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	101 —104 %	101½	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8¾— 9¼	8¾— 9¼	..	..
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13	12¾	12
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	..	25 — 27	25 — 27	25¾	..
66,900£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	⅛— ¼	⅛— ¼	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	½— 1	½— 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	97 — 99	98 —100	99½	97½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	70 — 72	69 — 71	73	70½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12¾	12⅞
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅛
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	95 — 98	98	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102½	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞— 1	⅞— 1	⅞	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7¼	6¾— 7¼	..	..
2,303	Submarine Cables Trust	Cert.	..	..	..	105 —115	105 —115	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5¼— 5⅝	5¼— 5⅝	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¼— 5¼	4¼— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	11 — 12	11 — 12	11⅛	..
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	96 — 99	98½	98
88,321	West India and Panama Telegraph	10	½%	..	..	⅜— ¾	⅜— ¾	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6½— 7	6⅞	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	4 — 5	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13½— 14	13½— 14	13⅞	13⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	12 — 12½	12⅝	12⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126½	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	7¾— 8	7¾— 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Brown, Lindley & Co., Ord.	£1	8 %	Nil	..	12/6 to 13/6	12/6 to 13/6	..	..
98,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1 — 1⅛	1 — 1⅛	1⅛	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1⅛— 2⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	91 — 96	90 — 95	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	..	13½— 14½	13½— 14½	15⅝	15⅛
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	110	..
1,950,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	105 —108	105 —108	106½	106
494,038	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	103 —106	103 —106	105	104½
494,988	Do. do. Def. do.	Stock	..	4 %	4 %	108 —111	108 —111	108	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	76 — 77	75½— 76½	76½	76
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2½— 3	2½— 3	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	⅛— ⅜	⅛— ⅜	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2⅛	1½— 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½— 2	1½— 2	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2½— 3	2½— 3	2⅛	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	98 —101	100¼	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15½— 16½	15 — 16 xd	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5¼— 5⅝	5 — 5½ xd	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111 xd	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	19⅛	18⅝
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	101 —104	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅜— 5⅝	5⅜— 5⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14¾— 15½	14¾— 15½	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	38 — 41	36 — 39	38½	38¼
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	99	..

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, ½—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Mar. 11th.	Closing Quotations Mar. 18th.	Business done week ended Mar. 18th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	‡ £1	..	..	..	¾ — 1	¾ — 1	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	115 —118	120 —123	120	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10½ — 11	10½ — 10⅝ xd	10⅞	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	9½ — 10½	9½ — 10½ xd	9½	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9½	9 — 9½	9⅜	..
70,000	Do. do. 4½% Cum. Pref.	5	..	..	..	5½ — 6	5½ — 6	5⅞	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4½ — 5½	4½ — 5½	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	105	104
44,486	Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6½	6 — 6½	6⅛	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	109 —112	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10 — 11	9½ — 10½ xd	10½	10
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13½ — 14½	13½ — 14½ xd	13⅝	13½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —106	103 —106	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	9 — 10	8½ — 9½	9⅛	9⅛
20,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	..	..	12 — 13	12 — 13	..	..
400,000	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7	6½ — 7	6⅞	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	6⅜	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½ — 11½	10½ — 11½	11½	11
90,000	Do. do. 4 % Debenture Stock	Stock	..	..	..	100 —108	100 —103	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2½ — 2⅝	2½ — 2⅝	..	..
49,840	Do. do. 6 % Pref.	5	..	..	..	5⅜ — 6½	5⅜ — 6 xd	5⅜	..
250,000	Do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —103	102½	101½
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	18½ — 19	18½ — 19½	19	18½
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —113	108 —113	110	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,853	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14½ — 15½	14 — 15 xd	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅜	15⅛
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	..	8½ — 9½	8½ — 9½	..	..
150,000	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	99	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	2½ — 3	3 — 3½	..	..
50,000	Do. do. 4% Deb.	100	..	..	..	86 — 91	88 — 93	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3½ — 3⅝	3½ — 3⅝	3⅝	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4½ — 5½	4½ — 5½	..	..
90,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½ — 5½	4½ — 5½	5⅛	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅝	12⅜
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6½ — 6⅝	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, March 18th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£36 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£23 15	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (76/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	119/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£148	..
b ,, Wire, in ton lots	per ton	£224	..
b ,, Sheet, in ton lots	per ton	£191	..
p Babbitt's metal ingots	per ton	£42 to £143	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	..
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	7½d.	..
c Copper Tubes (brazed)	per lb.	9½d.	..
,, ,, (solid drawn)	per lb.	9¾d.	..
Copper Bars (best selected	per ton	£78	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£78	..
g ,, Rod	per ton	£78	..
e ,, (Electrolytic) Bars	per ton	£69 15	85/- inc.
e ,, ,, Sheets	per ton	£81	£3 inc.
e ,, ,, Rod	per ton	£71 10	£3 inc.
e ,, ,, H.C. Wire	per lb.	8¾d.	¼d. inc.
f Ebonite Rod	per lb.	3/-	..
f ,, Sheet	per lb.	5/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/9½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	51/10	11d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£14	inc.
g ,, ,, Sheet	per ton	£13 2 6	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in ginal cases) small	per lb.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	..
d ,, ,, large	per lb.	3/8 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/8	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9½d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£137 10 to £138 10	70/- dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/10	..
p White Anti-friction Metals—"White Ant" brand	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7½d.	..
j ,, 6 les. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4¾d.	..
j ,, 160 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26 15	£1 inc.

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons., Ltd. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.P. and Teleg. Works g Messrs. James & Shakspeare [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys.	Mar. 13	704	+ 91	30,609	+ 4,801	12½	13½
Blackpool and Fleetwood	,, 14	226	+ 38	2,048	+ 326	7½	7½
Bristol Trys. & Car. Co.	,, 13	4,255	+259	—	—	28	28
British Elec. Trac. Co.:—							
Barnsley District	Mar. 6	158	—	1,441	—	—	—
Devonport	,, 6	304	-101	3,489	— 79	5	5
Dudley—Stourbridge	,, 6	699	+ 38	6,255	+ 643	18½	18½
Gateshead	,, 6	819	+172	7,488	+ 1,731	10½	9½
Gravesend—Northfleet	,, 6	176	—	1,5-5	—	3½	—
Greenock—Pt. Glasgow	,, 6	488	+ 24	3,699	+ 388	7½	7½
Hartlepool	,, 6	227	+ 49	1,974	+ 427	6½	4½
Kidderminster	,, 6	96	+ 1	*900	+ 81	4½	4½
Merthyr	,, 6	190	— 21	1,563	— 161	3	3
Middleton	,, 6	230	—	2,088	—	2½	—
Oldham—Ashton	,, 6	518	+ 22	4,795	+ 542	8	8
Peterborough	,, 6	109	—	805	—	—	—
Poole	,, 6	231	+ 24	2,067	+ 441	3½	3½
Potteries	,, 6	1,463	+ 73	13,645	+ 1,222	20½	20½
Rotherham	,, 6	41	+11	371	+ 102	—	—

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
B.E.T. Co. (*continued*)—							
Southport	Mar. 6	216	+ 75	1,942	+ 815	5½	5½
South Staffordshire	,, 6	755	+ 18	6,266	— 196	21½	22½
Swansea	,, 6	440	+ 28	4,004	+ 367	6½	6½
Taunton	,, 6	49	— 9	443	— 87	1½	1½
Tynemouth	,, 6	207	+ 1	1,881	+ 220	3½	3½
Weston-super-Mare	,, 4	26	—	122	—	2½	2½
Wolverhampton Dist.	,, 6	341	+183	3,079	+ 1,768	10½	9½
Yorkshire Wollen Dist.	,, 6	133	—	320	—	6	6
Central London Railway	,, 14	7,112	+330	76,727	+ 3,822	6½	6½
City and S. London Ry.	,, 15	3,090	+ 90	35,+06	+ 2,335	5½	5½
Dover Corporation Trys.	,, 14	188	— 16	1,824	+ 42	3	3
Dublin United Trys.	,, 13	4,806	+229	49,764	+ 2,761	45	45
East Ham Tramways	,, 14	368	+142	18,677	+ 4,594	5	4
Glasgow Corp. Trys.	,, 14	12,935	+1,914	5.2,211	+16,288	83	83
Liverpool Overhead Ry.	,, 15	1,514	+ 64	16,846	+ 1,257	6½	6½
Newcastle Corp. Trys.	,, 14	3,087	+1,121	—	—	25	—
Sunderland Corp. Trys.	,, 8	971	— 43	—	—	17½	17½

* Compared with the corresponding period of 1902.

THE MURRAY PRINTING TELEGRAPH.

(*Continued from page* 460.)

Fig. 5 shows a punch block withdrawn when a key is depressed.

The spacing mechanism is shown in fig. 6. Rigidly attached to the shaft 56 is a small sprocket wheel, 53, which feeds the tape 57 along

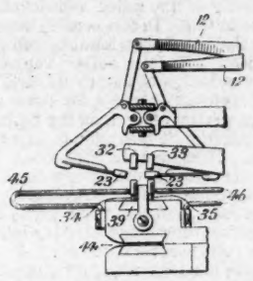


Fig. 5.

by means of the centre perforations. On the same shaft as the sprocket is a small ratchet, 54, controlled by the escapement anchor, 55, pinned to a shaft, 62. The tape passes over the guide plate, 58, beneath the punches, 34 and 35, over the pins of the sprocket wheel, and out of the machine. The small rollers, 59 and 60, carried by the snap lever, 61, keep the tape on the sprocket, and the lever, 61, is pivoted so that it may be thrown back into the dotted line position to allow a new tape to be threaded in. The armature of the spacing magnet is attached to shaft 62 and thus controls the

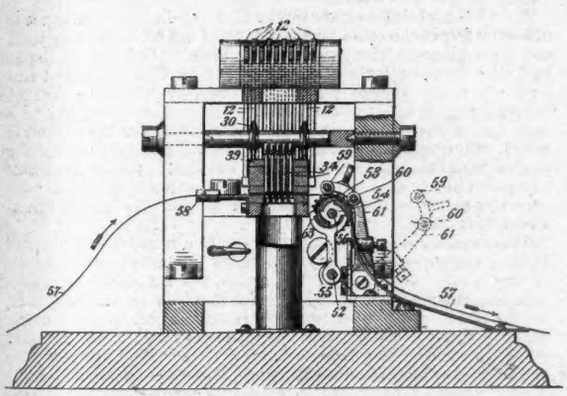


Fig. 6.

escapement anchor, the ratchet, and the sprocket wheel. The shaft, 56, is driven by a small shunt-wound motor, connected up through a spring box, the action of which is explained later on in the description of the recorder.

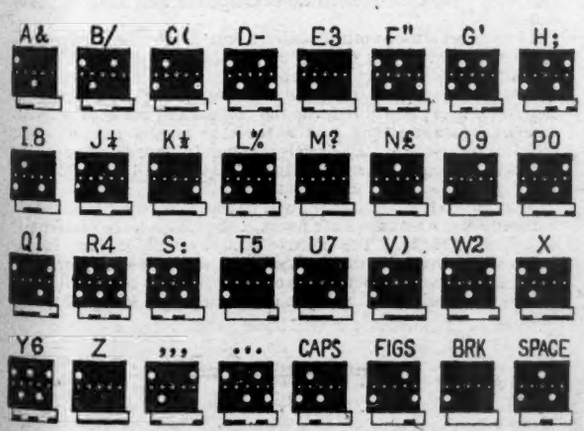


Fig. 7.

The punching and spacing magnets are operated alternately by two electric contacts. While the 10 fiddlebows, 6, are pivoted so as to rock up and down on the same shaft, 4, as the keys 3 and the kickers 7, there is an eleventh fiddlebow 81, which rocks on a separate shaft 82 (see fig. 4). This fiddlebow 81, which is operated by each and all of the keys, carries a projecting arm which rocks between the spacing and punching contacts, when a key is depressed. The normal position for this arm, when no keys are depressed, is against the spacing stop. Consequently, when this spacing circuit is closed, preliminary to operating the machine, the spacing magnet is energised and the escapement anchor 55 is thus drawn over, so that a tooth of the ratchet is retained by one of the arms 63 of the anchor (fig. 6). This is the normal condition of the spacing mechanism, the feeding being effected by the breaking and closing of the spacing circuit. When a key is depressed the spacing fiddlebow, 81, breaks the spacing contact the moment the key is touched. This releases the armature of the spacing magnet; the anchor flies back and the sprocket wheel feeds the tape forward one-third of a letter space. The further depression of the key carries the contact arm over to the punching stop. The moment this happens the punching armature, 36, is attracted, and the punches are driven through the tape as previously explained. On releasing the key the punching circuit is broken, the punches are withdrawn, and the moment the contact arm touches the spacing stop the spacing circuit is again closed, and the tape is fed forward the remaining two-thirds of the letter space. What actually happens is that, just prior to depressing a key, one-third of the last letter punched remains under the punches. The breaking of the spacing circuit by the depression of a key moves the tape forward one-third of a letter space, thus bringing a new letter space in proper alignment under the punches.

When handling short messages such as commercial telegrams, consisting mostly of short lines which cannot be arbitrarily divided like a press despatch, it is necessary to have a break signal which will automatically stop the printing mechanism at the end of each line. This break signal has to be transmitted like any other letter, and in order to ensure its insertion at suitable intervals, a line bell is provided to prevent a perforator operator exceeding the length of a line before inserting the break signal.

Fig. 7 shows the transmitted alphabet, the broken lines under each letter denoting the length of the marking current sent to line.

The speed of these perforators depends, of course, upon the operator; but it may be mentioned in connection with this point that the average speed of a typist printing from copy is about 50 words per minute, so that three perforators are ample provision for each end of a circuit.

Transmitting Vibrator.—This consists of an iron reed, which vibrates between two adjustable contacts, and is actuated by two pairs of electro-magnets, the circuits of which are alternately opened and closed at these contacts. Movable weights are applied at the free end of the reed for regulating the speed of vibration. The function of this vibrator is to alternately energise two electro-magnets fitted at the back of the transmitter, which drive a wheel substantially similar to the well-known La Cour phonic wheel device. This operates the mechanism of the transmitter, which is provided with a starting and stopping switch.

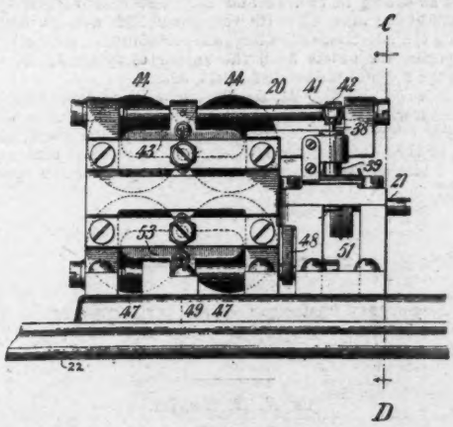


Fig. 8.

The Transmitter.—This is a modification of the ordinary Wheatstone form of instrument, and is constructed so that the vertical needles or prickers, which are in line with the advancing lines of perforations in the tape, move or reciprocate together by the action of the rocking bar, thereby enabling any desired multiple of a single impulse to be sent to line. A system of gearing is employed between the phonic wheel and the spindle of the crank which operates the rocking bar, the object of this being to secure a rapid movement of the prickers from a comparatively slow rate of vibration of the reed. With the feed wheel in use and the transmitter running without tape, fragmentary currents only are sent to line instead of reversals; but to meet this requirement Mr. Murray has provided a second wheel, the periphery of which is slotted in such a manner that the prickers are allowed to reciprocate alternately. Each wheel can be brought into use as desired by a suitable switch. The ordinary arrangement of the Wheatstone transmitter can only transmit unit signals or an odd multiple thereof; it is practically an alternating current generator. The Wheatstone signals have to be built up by omitting a positive or a negative impulse, hence an ordinary transmitter can transmit a dot or a dash equal to three dots, but cannot transmit a dash equal to two or four dots. To avoid this difficulty, as previously explained, Mr. Murray has arranged the needles to reciprocate together instead of alternately.

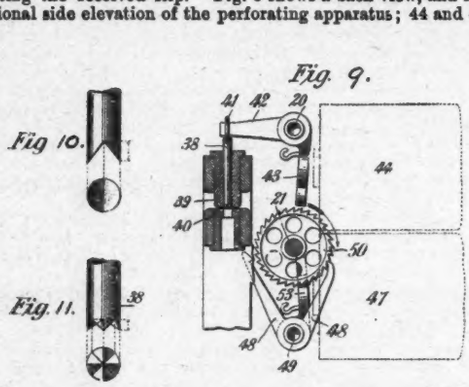
There are thus obtainable transmitted impulses or dashes equal to one, two, three, four, or five dots.

This completes the transmitting mechanism. At the receiving station the arriving signals operate an ordinary Post Office standard relay, which in its turn controls a group of local instruments, the duty of which is to record the incoming signals in the form of perforations in the receiving tape. These local instruments are as follows:—

Local Relays.—These are simply two electro-magnets fitted on the same base and connected in series. The armature of each plays between two limiting stops, which are adjustable, and spiral springs are employed to hold the armatures against the back stops when the cores are demagnetised. The adjustment of these springs and contacts plays a most important part in the working of the system. The back stop of one of the electro-magnets, shown on the left in fig. 1, is fitted with an insulated point. The contacts of the other electro-magnet are short circuited. The former electro-magnet is termed the punching relay, and the latter the governing relay.

The Recorder.—Distributed on the same base are a small shunt-wound motor, a tape-stopping relay, and the mechanism for perforating the received slip. Fig. 8 shows a back view, and fig. 9 a sectional side elevation of the perforating apparatus; 44 and 47 are

Fig. 9.



two electro-magnets, the former being termed the punching, and the latter the spacing magnet. The armature of each, 43 and 53, is controlled by an extra strong spiral spring, and the levers carrying the armatures are attached to the spindles, 20 and 49, supported on pivots at their extremities. To the upper spindle is fixed a rigid arm, 42, which operates a punch, 38, the cutting surface of which is arranged as shown in figs. 10 and 11. The heart-shaped spring, 41, connects the arm, 42, with the punch, 38, and is used for retracting the punch smartly after each perforation. On the spindle of the spacing magnet is fixed the anchor escapement, 48, which engages the teeth of the ratchet wheel, 50.

The axle or spindle, 21, supporting this ratchet wheel also carries a sprocket wheel, 51, and is driven by the motor already referred to. Through the slit between the punch block, 39, and die, 40, is threaded the tape which has previously been centre-holed. These holes are now engaged by the pins of the sprocket-wheel.

(To be continued.)

SOME VIEWS ON ELECTRIC TRACTION.

By W. H. BOOTH.

Not many years ago the cable roads of America held the field. They were rapidly abolishing horse traction. We were being urged to adopt them in England, and actually did go so far as to build cable roads up Highgate Hill, in Birmingham, on Brixton Hill, and in that dark and gruesome tube railroad of Glasgow. Also there was the line in Edinburgh, a piece of folly that was laid down after cable roads had been condemned.

Still, five cable roads in all, are not a very serious collection of errors. We have not had to pull up much cable road as have the Americans, who are a little apt to fall over themselves in trying new things. As with the cable roads, so have we been upbraided for our slowness with electric traction, and the shallow thinkers have, as usual, held up America as an example. But America with its mile of railroad to 20 square miles of country is a better field for railroads of any sort than the British Isles with a mile of line to each six square miles of country.

America had a greater shortage of railroads, and simply put into tramroads the money that would otherwise have gone into steam railroads.

There is no proper basis of comparison between us and America—a little island and a huge unfinished Continent. Moreover, have we not our roads? There are few roads in America, fewer good roads, and not a road, probably, in the country to call a road, alongside those of Great Britain or of France. These roads, a heritage from the past, are made and mostly paid for. They are dotted from end to end with inns, whose "clay from long oblivion has gone dry." To some extent they have been revived by the gentlemen on castors, and have experienced something of the glories of this world.

What is a rail? It is simply a narrow strip of hard road surface, the advantage of which, as a piece of good surface, is gained by a sacrifice of other more or less commendable virtues. One thing sacrificed is freedom to pass both on the part of the railed vehicle, and in frequent cases of the free vehicle, which is considerably hampered especially on narrow roads. Other disadvantages are the constrainment laterally of the railed vehicle and the shocks upon its construction due to this. In this country we take away much of the advantage of the hard smooth rail by rolling in it a groove to hold mud, sand, gravel and frost nails. The Americans don't do this. They employ raised rails, but, to do them justice, the raised rail renders the roadway little worse, for the roadway is, initially, shall we say, in less perfect order than the Bath road. When they do make a road in America, it is so wide that its total cost precludes sound construction. Here and in France we have learned that roads ought to be narrow. In our thousands of miles of roads we have a vast accumulation of locked-up capital. Our fathers travelled in glee along these roads, and sent their goods along them at rates very much less than those now extorted by the railroads, who seem to profit nothing from their hard rail surfaces.

The tramway never has been much of a success in this country. George Francis Train, who is supposed to have brought it over, thought that what was needed on the bad roads of his own country might serve here; but he did not reckon upon good roads largely used, and the street tramway has not done well.

There would to-day probably be no street tramways at all in Britain if the foolish red flag legislation had not killed off the steam carriages of Gurney and of Hancock. The work of these men had proved a success. It was killed by legislation of the 2 miles per hour order, and we have suffered tramvitis in consequence. But Train never introduced this.

There was a tramway, for example, to name only one, through the streets of Merthyr Tydvil, and a tramway locomotive ran from the Pen-y-Darren works (on the site of which, curiously enough, stands about the earliest power house of an electric tramway in Wales) to the canal wharf.

To-day thoughtful men are saying that the electric tramway is to suffer the fate of the cable roads; it is to be cut off in its early youth and give place to the automobile vehicle. Coil boilers, liquid fuel, and comparatively slight advances on the mechanical construction of the Gurney vehicle generally, with freedom, have put the road engine on its wheels again. Every day sees it become a more formidable competitor. The chief drawback is the pneumatic wheel. Costing 3d. per mile, the wheels are the greatest obstacle to a universal success. Moreover, the pneumatic tire, and probably any yielding tire, is very injurious to a macadam road surface; and even this points to the desirability of a solid tire and a spring-wheel, if it can be found.

There cannot be any question that the free-wheel motor omnibus is far away superior in many respects to the railed car, especially in city work. For country roads, also, the automobile dispenses with the heavy capital outlay which is involved in tramway track, in the paving which often unfairly is saddled upon the tramway which uses it not, and in the overhead work. Still, the overhead work is a small item compared with the track, and it may prove the salvation of electric traction work, if we use free vehicles with trolley poles of various lengths taking power from overhead wires and running over all the road surface; this the vehicles may do without the formation of ruts which might attend the use of a uniform length of trolley pole.

We may look forward to the next few years being fruitful in motor vehicle advance, especially in mechanical construction. The tramway will find a hard competitor in the free vehicle, and the free vehicle will afford the best excuse for refusing a right to a tramway. The field of electrical development will, however, not be closed.

The present steam-worked railways will find in electricity a new motive agent, and will employ all the capital now employed in manufacturing tramway material.

The increase of road traffic will first resuscitate the old inns, then build new ones; it will liven up the villages and the decayed small towns, take many people back to the country, and possibly effect, what all are crying out for, namely, a return to the land. The electric tramway has made the suburbs, the automobile will re-establish the country, and it will do so without interfering with the proper field of electric traction. This field will be found in the present steam railroads in the perhaps near future, and perhaps more particularly in suburban traffic. The electric tramway will, in fact, largely increase the area upon which cities and towns now stand, for it will carry the residential population to the outskirts. But it will never occupy the field that lies open and untilled awaiting the automobile.

STREET LIGHTING IN WESTMINSTER.

A number of interesting reports relating to the various systems of street lighting in use in the City of Westminster have been issued by Mr. J. W. Bradley, the City engineer. The reports deal with arc lamps maintained by three electric supply companies, incandescent gas mantles, Sugg's high pressure burners with mantles, and ordinary flat-flame burners. Actual tests of candle-power were

made on the lamps *in situ*, and the total costs are expressed in terms of pence per candle-power per annum. The following are the principal data (Quarterly Report, No. 2, September, 1902):—

Tests of Street Lamps (Gas and Electric) with Statement of Comparative Costs.

Description and position of lamps.	No. of lamps tested.	Average candle-power.	Capital cost of lamp.	Interest and sinking fund per lamp per annum.	Cost of illuminant per lamp per annum.	Cost of lighting and maintenance per lamp per annum.	Total cost per lamp per annum.	Total cost per candle-power per annum.	Height of lamp.
			£				£ s. d.	d.	
1. Electric arcs, Whitehall Place and Northumberland Avenue (Charing Cross and Strand Electric Light Co.) 500 watts.	6	937	40	30 years, say, £2.	£28		30 0 0	7·7	22 ft. 6 in.
2. Electric arcs, Pall Mall (St. James's and Pall Mall Electric Supply Co.) 500 watts.	6	598	45	14 years, say, £4.	£30		34 0 0	13·6	20 ft. 6 in.
3. Electric arcs, Grosvenor Place (Westminster Electric Supply Corporation) 500 watts.	5	691	—	—	£22	—	22 0 0	7·65	22 ft. 6 in.
4. No test	—	—	—	—	—	—	—	—	—
					£ s. d.	£ s. d.			
5. Sugg's high pressure burners in Whitehall, incandescent mantles.	5	552	15	30 years, say, 15s.	13 6 2	4 3 10	18 5 0	7·95	14 ft. 6 in.
6. Ordinary single burner, incandescent mantle, on footways, Victoria Street (4·2 cb. ft. per hour).	6	62	6	Do. 6s.	2 0 0	1 4 0	3 10 0	13·5	11 ft. 6 in.
7. Ordinary flat flame burners, footway in Whitehall, three burners, 18·48 ft. per hour.	6	61*	8	Do. 8s.	£5 0 2		5 18 2	24·6*	12 ft. 3 in.
8. Ordinary single burner, incandescent mantle, Carlton House Terrace (3·25 cb. ft. per hour).	5	37	6	Do. 6s.	1 10 11	1 1 0	2 17 11	18·8	10 ft. 6 in. 11 ft. 6 in.
9. Ordinary flat flame burners, footway, Chandos Street, Strand, 3 × 5 cb. ft. per hour.	6	55	8	Do. 8s.	£9 0 10		9 8 10	41·1	12 ft. 0 in.

* Only give this candle-power up to midnight. Burn 5 cb. ft. after midnight.

In a separate report the engineer gives the details of his photometric tests, made from April to September last year. All the arc lamps were rated at 500 watts each (the report says "watts *per hour*"!). Other types of lamps were tested besides those here referred to, but the costs are not stated.

A valuable table deduced from the foregoing results is given, showing the distance apart at which the various lamps should be placed, in order to give an illumination midway between them, at the level of the pavement, equal to that of one candle at a distance of 3 ft. This we reproduce below:—

Description of work.	No. of tests.	Average candle-power.	Average height of column.	Distance apart in feet.	No. of lamps per mile.
			ft. in.	ft.	
1. Electric arc lamp ...	50	670	22 0	107	49
2. Sugg's high pressure ...	15	494	14 6	93	57
3. Flat flame, 18·48 ft. per hour	9	61	12 3	31	170
4. Incandescent mantle, 4·2 ft. per hour	16	58	11 6	30	174

The engineer points out that these values apply only to the conditions which obtained at the time of testing.

The agreement with the Westminster Electric Supply Co. provides for the supply and fixing of at least 600 arc lamps for a period of 30 years. The lighting hours are 3,940 per annum, and the annual charges are £32 per 750-watt lamp, with 1·92d. per hour for extra lighting; £22 per 500-watt lamp, and 1·32d.; £4 per 120-watt incandescent lamp, and ·24d; and £3 per 60-watt ditto., and ·18d. The charges are to be reduced by ¼ per cent per annum, and they can be referred to arbitration if necessary at the 10th and 20th years, if improved methods are introduced in the meantime. The cost of gas lighting in the parish of St. George previously averaged £9,700 per annum; electric lighting costs £21,914, but of course the standard of lighting is much higher, there being 953 arc lamps and 217 glow lamps.

In the parish of St. Martin-in-the-Fields the Charing Cross and Strand Co. has installed 100 arc lamps under a 21-years agreement, at £28 per lamp per annum and 1·5d. per hour for extra lighting.

The St. James' and Pall Mall Co. has about 66 arc lamps in the parish of St. James, under a 7-years agreement which expires next November, when the agreement becomes annual. These cost £30 per lamp per annum, and 2d. per hour for extra lighting.

The Strand is to be lighted with arc lamps in place of the experimental gas lamps placed there by the late Strand District Board.

The cost of lighting the Strand with flat-flame gas burners amounted to no less than £582 per mile, while in St. George's, which is lighted almost entirely with arc lamps, the cost was £524 per mile. Needless to say, the quality of the lighting in the two districts will not bear comparison! To emphasise the difference, Mr. Bradley contrasts the lighting of Buckingham Palace Road by arc lamps at the rate of 36 columns per mile, with that of Victoria Street by incandescent gas lamps at the rate of 97 columns per mile, "the comparative costs per mile being £795 to £426; but the general appearance in the latter case is very inferior to the former, and the street surface illumination much lower." "A lamp with a height of 20 ft. would appear to be a minimum requirement, as giving light, not only at ground level and on the top of an omnibus, but through a stratum 20 ft. thick." After emphasising the desirability of lighting, not merely the pavement, but the whole street, as Piccadilly Circus, for example, is lighted, the engineer emphatically advocates lamps of 700 to 1,000 c.p., placed at the head of artistic columns, 20 to 22 ft. high, to give the diffused and powerful lighting which is not a luxury, but a necessity in such a city as Westminster.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON ELECTRONS.

By Sir Oliver Lodge, F.R.S., Vice-President.

(*Paper read in London, November 27th*, 1902.)

(*Continued from page* 462.)

Aitken and Cloud Nuclei.

First of all, Mr. John Aitken,* of Edinburgh, discovered in 1880 that cloud or mist globules could not form without solid nuclei, so that in perfectly clear and dust-free air aqueous vapour did not condense, and mist did not form. (See, for instance, my lecture to the British Association at Montreal in 1884, on "Dust"—*Nature*, Vol. 31, p. 268.)

Without solid surfaces, in clear space, vapours could become supersaturated; but the introduction of a nucleus would immediately start condensation, and according to the number of nuclei, or condensation centres, so will be the number of cloud globules formed.

Every cloud or mist globule is essentially a minute raindrop, not floating in the least, but falling through the air—falling slowly because it is of such insignificant weight and is moving in a resisting medium—but falling always relatively to the air. A cloud may readily be carried up by a current of air, but that is only because the air is moving up faster than the drops are trickling down through it. No motion of the air disturbs the relative falling motion: the absolute motion with reference to the earth's surface is the resultant of the two.

* *Trans. R.S. Edin.*, 1880.

The fact that nuclei are required for mist precipitation can be proved by filtering them out with cotton wool, and finding that as the nuclei get fewer the mist condensation differs in character, becoming ultimately what is called a Scotch mist, such as forms in fairly clean air; where since the dust particles are comparatively few, the centres of condensation are few also, and accordingly each has to condense a considerable amount, so that the drops are bigger, and not nearly so close together; wherefore they fall quicker like very fine rain. In perfectly clean elaborately-filtered air the dew point may be passed without any vapour condensing, and the space will remain quite transparent in spite of its being supersaturated with vapour.

The reason for this effect of, and necessity for, nuclei, is well-known in the light of Lord Kelvin's theory concerning the effect of curvature on surface tension,* because the more a liquid surface is curved the more it tends to evaporate, and an infinitely convex surface would immediately flash off into vapour. Consequently an infinitesimal globule of liquid cannot exist; vapour can only condense on a surface of finite curvature, such as is afforded by a dust particle or other body consisting of a large aggregate of atoms. For it must be remembered that a single grain of lycopodium powder contains about a trillion atoms, and a dust particle big enough to condense vapour need not consist of more than a billion, or perhaps not more than a million atoms, and need by no means be big enough to be visible It is, however, material enough to be stopped by a properly packed cotton-wool filter.

J. J. Thomson and Electrical Nuclei.

In 1888 it was shown by J. J. Thomson, in his book "Applications of Dynamics to Physics and Chemistry," p. 164, that electrification of a body would partially neutralise the effect of curvature, and so assist the condensation of vapour on a convex surface.

Consider a drop of liquid, or a soap bubble; the effect of the convexity of the surface is to give a radial component of surface tension inwards, causing an increased pressure internally. The effect of electrification is just the opposite: it causes a direct pressure outwards, which goes by the name of the electric tension.

The way these depend on size is as follows:—

The radial pressure component of the surface tension, T, is

$$\frac{2T}{r} \text{ inwards.}$$

The electric pressure or tension is

$$2\pi K\sigma^2 = \frac{e^2}{8\pi K r^4} \text{ outwards.}$$

They are differently affected, therefore, by the size of the globule; hence at some size or other they must balance, and such an electrified convex surface will behave as if it were unelectrified but flat. Accordingly vapour which would refuse to condense on an ordinary convex surface, until far below the dew point, will begin to condense on it, if sufficiently electrified, the instant the dew point is reached.

The critical size at which the ionic charge enables a sphere of water to act as regards condensation as if it were flat, can be reckoned by equating the pressure to the tension, thus:—

$$\frac{2T}{r} = \frac{e^2}{8\pi K r^4}$$

or $$r^3 = \frac{e^2}{8\pi KT} = \frac{10^{-21}}{25 \times 80} = \frac{1}{2} \times 10^{-23} \text{ c.c.}$$

whence $r = \frac{1}{3}\,10^{-8}$ approximately, or is of atomic magnitude.

Hence *ions* can condense vapour; and anything smaller which possesses the same charge can condense it still more easily.

In moist air, therefore, it would appear (parenthetically) as if electrons could hardly exist isolated, but must be associated with at least an atomic mass of matter.

Accordingly an electric charge assists vapour to condense; and a sufficient electric charge might cause it to condense on quite a small body—as small even as an atom, or smaller. Hence in the presence of electrified ions or electrons, dust particles are not necessary for condensation. Vapour may condense on these electrical nuclei without the need for solids of finite curvature. The electrical nuclei cannot be filtered out by cotton wool; they will exist or can be produced in dust free air. No doubt if they are passed through a great amount of metal gauze, they may be diminished in number, but they are not easy to get rid of except by their own diffusion, which does ultimately enable them to pair off or to migrate to the sides of the vessel. They can be got rid of most easily, however, by electrolysing the air, that is to say, by supplying electrodes maintained at a few volts difference of potential. They will then immediately make a procession, as in electrolysis, only with much greater speed, because their motion is much less resisted or interfered with by chance collisions; so they will soon reach and cling to their respective electrodes, and in that case again no true mist can form.

While ions or electrons are present in considerable numbers, a thick mist will form whenever the space is saturated with vapour, but it will be a mist of different appearance from the slight rain-like condensation which may be seen forming round the few residual dust particles. The mist globules will usually be of uniform size, and some estimate of that size can be roughly attempted by the diffraction colours, which can be seen if a point of light is looked at through the mist: not, however, a very easy plan of making a trustworthy estimate.*

Electrical nuclei can be produced in various way—by anything, in fact, which dissociates the air or which fills it with ions. Some are produced by the splashing and spray of water, some are given off from flames, and from red-hot bodies, they are produced in considerable numbers when Röntgen rays travel through air, they can be given off by radio-active substances like uranium, and they are easily emitted by a negatively-charged metallic surface exposed to ultra-violet light.

Wilson and Metrical Cloud Condensation.

Mr. C. T. R. Wilson,† in his study at the Cavendish Laboratory of cloud formation under the influence of Röntgen rays and by other methods, devised a plan for precipitating a definite and known quantity of aqueous vapour in a visible form. This was done by an arrangement for making a sudden or adiabatic expansion of saturated air, and making it to a carefully measured amount. The apparatus employed is shown in fig. 3.

One test-tube moving inside another is employed as a piston, and by a certain arrangement the piston was enabled to drop with great suddenness and thus to produce a measured small exhaustion in the

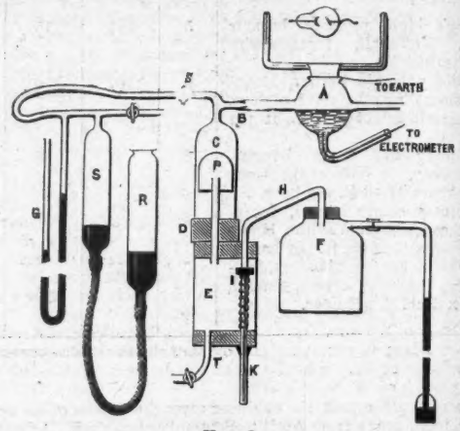


FIG. 3.

A is the vessel in which the fog is formed whose rate of fall is to be measured by Mr. Wilson's method as used by him for the ionisation produced by X rays. The vessel A, containing some water, is in communication with a vessel C through the tube B. Inside C is a thin walled test-tube P, which serves as a piston. D is an india-rubber stopper closing the end of tube C. A glass tube connects the inside of the test-tube P with a space E. This space may be put in connection with an exhausted space F through the tube H. The end of the tube H, inside the space E, is ground flat, and is closed by an india-rubber stopper I, which is kept pressed against the tube H by means of a spiral spring. The stopper I is fixed to a rod K; by pulling the rod down smartly the pressure inside the test-tube is lowered, and the piston P falls rapidly until it strikes against the india-rubber stopper D. The falling of the piston causes the gas in A to expand; the tubes R and S are for the purpose of regulating the amount of the expansion. The clip S is closed before an expansion; and the piston P is raised by a trifling amount of air introduced through T. Then, when everything is ready, K is pulled, and the cloud forms in A.

reservoir containing the gas under experiment; saturated as it is with vapour, and supplied with electric nuclei. The mist at once formed, and the drops began to fall slowly, as usual. Mr. Wilson tried to get an estimate of their size from the colours, but it was difficult and unsatisfactory. If the size had been known, their number would have been known, too, because the measured amount of expansion had produced a known fall of temperature below the

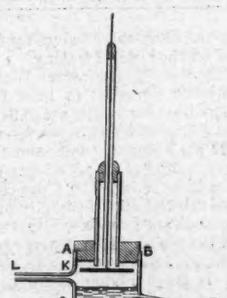


FIG. 4.

This figure corresponds closely with fig. 2, Part III., only that a layer of water replaces the wire gauze. The vessel was attached to the expansion apparatus, fig. 3.

dew point, and so had condensed a known amount of aqueous vapour, which would be distributed equally among all the equal globules.

It occurred to J. J. Thomson that a better estimate of size could

* See, for instance, Maxwell's "Theory of Heat," 1891 edition, page 290.

* See C. T. R. Wilson, *Phil. Trans.*, 1897, A, vol. 189, p. 283.
† *Phil. Trans.*, A, 1897, vol. 189, p. 265.

be made by observing their rate of falling, which is a thing not difficult to observe since they all fall together, being all of the same size. In any mist formed in a bell-jar it is easy to watch it settling down, by watching its fairly definite upper surface, a clear space being left above it which gradually increases in thickness as the cloud falls. The rate of movement of the top of the cloud will give the rate of falling of the individual globules of which it is composed; and this brings us to the next section.

Prof. Stokes and Falling Spheres.

Many years ago, in 1849, Sir George G. Stokes* discussed the motion of solids through fluids, and among others of a sphere moving through a viscous fluid urged by its own weight. It is a familiar fact that large bodies fall through air or water or any resisting medium more quickly than small ones of the same shape. Thus coarse sand settles down through water quicker than fine sand, and the finest powder takes a very long time to settle; in fact, this difference of the rate of falling is used as a practical process of separating granular materials into sizes, and is called levigation.

So it is in air; large raindrops fall violently, small raindrops fall gently, and mist globules hardly fall at all—fall so slowly that their motion is difficult to observe—but the same law governs all so long as the motion is not too violent, or so long as the falling body has no edges such as will cause eddies during the fall. A sphere falling slowly, controlled by viscosity alone without waves or eddies, is the simplest case. It soon reaches what is called a terminal velocity—the speed at which the viscous resistance exactly balances its weight. At this speed it is subject to zero resultant force, so it simply obeys the first law of motion and moves at a constant speed.† This constant speed or terminal velocity was calculated by Sir George Stokes for the case of a falling raindrop of radius r, as follows:—

$$c = \frac{2}{9} \frac{g \rho r^2}{\text{viscosity of air}},$$

where ρ is the excess density of the sphere over the medium it moves in; provided there is no finite slip at the surface. The maximum possible effect of surface slip—which will occur to some extent when the falling globules are very minute—is to make the possible terminal velocity half as great again: in other words, to convert the numerical coefficient $\frac{2}{9}$ into $\frac{1}{3}$.

This simple formula gives the connection between the rate of fall of a raindrop and its size; and by observation of this speed, therefore, knowing the viscosity of air, it is possible to calculate the dimensions of the falling drops.

J. J. Thomson's Experiment of Counting.

We have now all the materials ready for understanding the experiment to be performed,‡ so as to count the ions which are produced in air under the impact of Röntgen rays, or when there are electrons to be counted which have been produced from a negatively electrified surface illuminated with ultra-violet light. The apparatus for the latter is depicted in fig. 4. A clean zinc surface in vacuo, faced by a piece of wire gauze through which the light could shine on it, and by a window of quartz which made the vessel air-tight, so that it might be exhausted and yet allow the ultra-violet light to pass, was employed as shown in fig. 2 above: the present arrangement is similar, except that a water surface replaces the gauze.

The rate of leak which gives the current $N e u$ is determined by connecting the water and the zinc plate to the terminals of an electrometer; the zinc plate being kept negative by means of a battery of a sufficient number of cells.

And now, supplying this apparatus with the adiabatic expansion appliances of C. T. R. Wilson shown in fig. 3 above, metrical condensation can be produced, a mist will form, and the rate of its fall can be observed; whence by Stokes's theorem the size of each globule is known; the quantity of water which had gone to form globules is known from the measured amount of expansion, by a process the details of which I will not give here; and so the number of such globules, and, therefore, the number of their condensation centres or nuclei or ions, can be determined.

If c is the observed rate of fall in stagnant air, the linear dimensions of the falling drops will be—

$$r = \sqrt{\left(\frac{9 \mu c}{2 g \rho}\right)} = \sqrt{\left(\frac{4{\cdot}5 \times {\cdot}00018}{981} c\right)} \text{ centimetres.}$$

In a given case c was observed to be 0·14 centimetre per second; hence the volume of each drop was in that case

$$\tfrac{4}{3} \pi r^3 = 1{\cdot}6 \times 10^{-10} \text{ c.c.};$$

and so if the aggregate amount of water in all the drops in a given space is reckoned from the measured amount of adiabatic expansion which caused the chill and the precipitation, the drops can be counted.

A great many precautions must be taken, because there will be *some* residual cloud found even when electrons or intended nuclei are not present. A differential observation is, therefore, necessary; moreover, care must be taken to ensure that all the nuclei are utilised, and not only a portion.

The number of drops found in a certain experiment by this means was about 30,000 to the cubic centimetre; the total quantity of water which went to form them being about the two-hundredth part of a milligramme.

Result.

The result of the execution of this ingenious counting process is, that the absolute charge and the absolute mass of an electron is at length directly determined. Hitherto we have determined by many and various ways the ratio e/m and the speed u. We have likewise been able to determine $N e u$ and $N e$ and $N m u^2$, as already explained.

Now at length we have determined N; and at once the terms in the ratio e/m are disentangled.

e comes out, as suspected, in all cases, the regular ionic charge, of the order of magnitude 3×10^{-10} electrostatic, or 10^{-20} electromagnetic units; hence m comes out for positive carriers and for ions the appropriate mass of the atoms present. In some cases the masses are greater than this, and represent molecular aggregates. But for the negative carriers set free by ultra-violet light, and for the other cases where $e/m = 10^7$, the masses come out definitely of the order 10^{-27} grammes; or about $\frac{1}{1000}$th part of the smallest and lightest previously known quantity of matter, viz., an atom of hydrogen.

The existence of masses smaller than atoms was thus experimentally demonstrated, and a discovery was clinched of epoch-making importance.

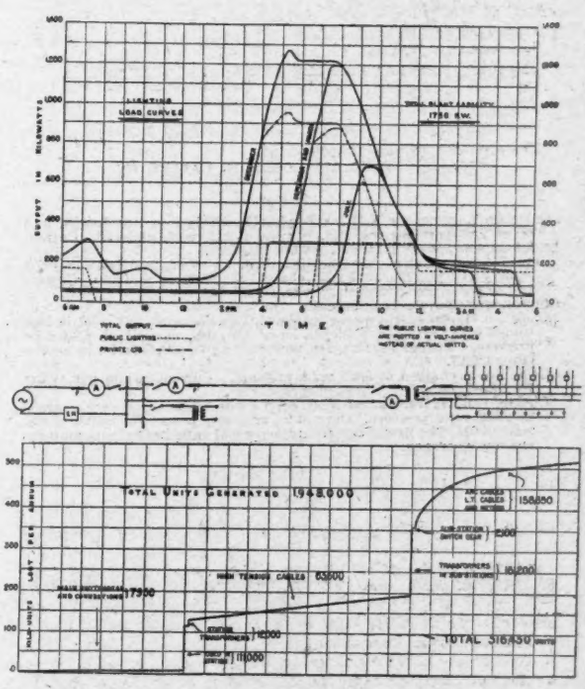
(To be continued.)

DISTRIBUTION LOSSES IN ELECTRIC SUPPLY SYSTEMS.

By A. D. Constable, A.M.I.E.E., and E. Fawssett, A.I.E.E.

(Abstract of paper read before the Inst.E.E., March 12th, 1903.)

As a rule, not more than 75 per cent. of the electrical energy generated in a central station is paid for. Of the balance—25 per cent.—four-fifths are wasted, and the remaining one-fifth is used in the station.



TOTAL UNITS GENERATED 1,968,000
ARC CABLES L.T. CABLES 158,250
SUB-STATION SWITCH GEAR 2,100
TRANSFORMERS IN SUB-STATIONS 10,200
MAIN SWITCHGEAR AND CONVERTERS 17,500
HIGH TENSION CABLES 63,600
TOTAL 316,450 UNITS

FIGS. 1 AND 2.

The figures given in the paper refer to the Croydon Electricity Works, in which the plant capacity is 1,250 KW., and the annual output 1,873,000 units. The current is alternating at 60 cycles per second.

Switchboard Losses.—These losses are due to the heating-up of the metal work and connections, and average from 0·3 to 0·43 per cent. of the output. In the sub-station switchgear the loss is 0·1 per cent. Altogether, this means an annual loss of 10,000 units.

Cable Losses.—These are the most important, and are made up of C^2R losses in the conductors and dielectric, and in dielectric hysteresis. The leakage losses are small, amounting to only 14 units per annum per mile of 2,000-volt feeders; and in the L.T. network (200 volts), including all switch-gear, boxes, and services, the loss is but 7 units per annum per mile of cable.

The C^2R losses amount to 150,600 units per annum, or 9·2 per cent. of the units sent out from the station.

The dielectric hysteresis loss was arrived at principally by direct measurement, by means of a wattmeter, of the watts used; by calculation from curves of pressure and current, and from oscillograph records; and by measuring the increased power necessary to drive an alternator when a cable was switched in.

In order to find out if, and how, the wave-forms and the values of current and voltage varied in different parts of a cable, six long cables were joined in series, and readings taken at each end, and at

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* *Camb. Trans. Phil. Soc.*, ix., 43.
† Cf. *Nature*, Vol. 31, p. 266.
‡ *Phil. Mag.*, December, 1898, and December, 1899.

the junction of the two middle cables, the four ends being accessible in the generating station. It was found that there was no rise in the voltage at the ends of the cable, nor any change in the shapes

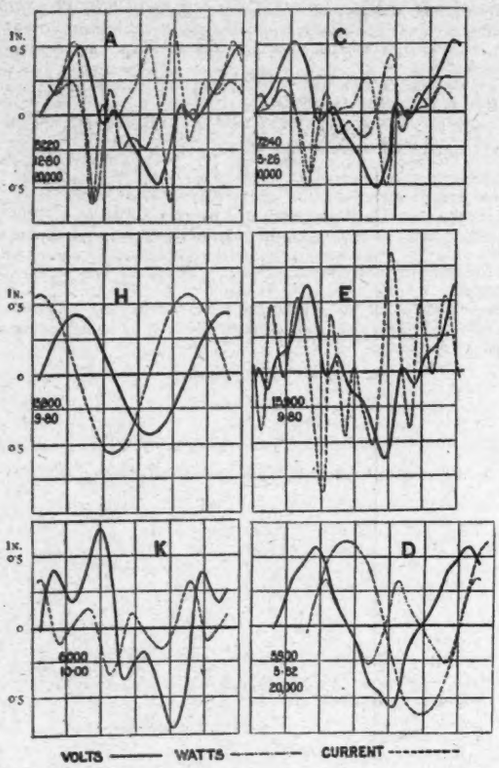

Fig. 3.—Dielectric Losses in Cables, &c.

A: Cable No. 7, concentric, V.B. insulated, laid solid in iron trough with iron cover, 7,290 yds. long. 8·46 mfd., charged at 2,090 volts pressure. Current 8·4 amperes, power 923 watts, power factor 0·13.
C: Cable No. 9, concentric, jute insulated, V.B. sheathed, laid solid in wood trough, 2,440 yds. long, 0·69 mfd., charged at 2,083 volts pressure. Current 1·06 amperes, power 58 watts, power factor 0·023.
H: Sine curves equivalent to Curves E.
E: Cable No. 11, concentric, paper insulated, V.B. sheathed, laid solid in iron trough with tile cover, 6,340 yds. long, 0·50 mfd., charged at 4,920 volts pressure. Current 3 83 amperes, power 237 watts, power factor by oscillograph 0·0127.
K: Cable No. 11, charged at 2,480 volts pressure. Current 1·6 amperes, power 309 watts, power factor by oscillograph 0·078.
D: Choking coil, 112 lbs. No. 16 S W.G. copper wire without iron core, charged at 2,060 volts pressure. Current 2·7 amperes, power 178 watts, power factor 0·032. The figures represent the scale of ordinates in volts, amperes and watts per inch.

marked difference between the behaviour of V.B. cables and others insulated with jute and paper. A number of oscillograms relating to these tests, selected from those given in the paper, are reproduced in fig. 3.

A table was also given of the relative values of the exciting current of a 30 kw. and a 120-kw. alternator, with and without connection to a circuit having capacity. When connected, there is a considerable saving, which is increased as the voltage is raised. On the whole, the V.B. cables appear to have higher dielectric loss than either jute or paper, and, of those tested, the power factors are, respectively, V.B., 0·12; jute, 0·035; and paper, 0 032 and 0 08. The V.B. cable is laid in an iron trough with an iron cover, which may account to some extent for the high power factor. That an external field exists around these cables is proved by the humming noise in telephones connected to pilot wires laid parallel and close to the cables.

The total dielectric hysteresis loss is 17,000 units per annum, which is less than 1 per cent. of the units sent out. It is not sufficient to warrant shutting down any of the feeders during light load.

Transformer Losses.—The transformers at Croydon are placed in 26 sub-stations and number 56, varying from 20 to 100-kw. capacity.

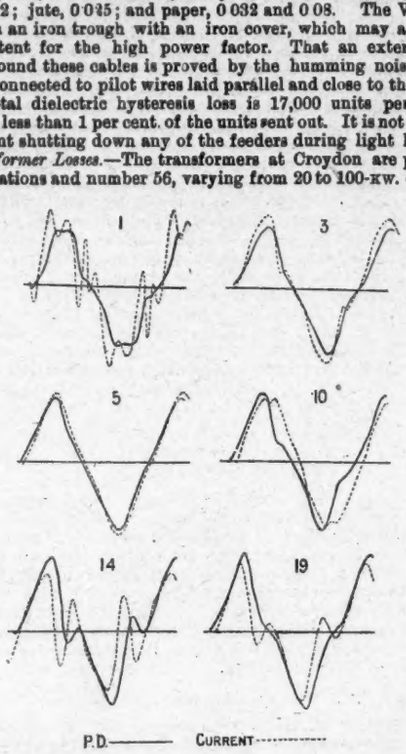

Fig 5.—Variation of Wave Form during 24 Hours.

1. 6.50 p.m. Total amps. 32. No. 7 machine. All transformers on, 5,000-volt cable on load.
3. 7.50 p.m. Total amps. 140. Nos. 6 and 7 machines.
5. 8.58 p.m. Total amps. 510. Nos. 5, 6 and 7 machines. Maximum load.
10. 1.0 a.m. Total amps. 100. No. 4 machine, Few transformers on.
14. 7.5 a.m. Total amps. 18. No. 3 machine. 5,000-volt cable off.
19. 6.40 p.m. Total amps. 90. No. 1. machine. 5,000-volt cable and all transformers on.

The P.D. waves are all to the same scale, but the current waves are to different scales.

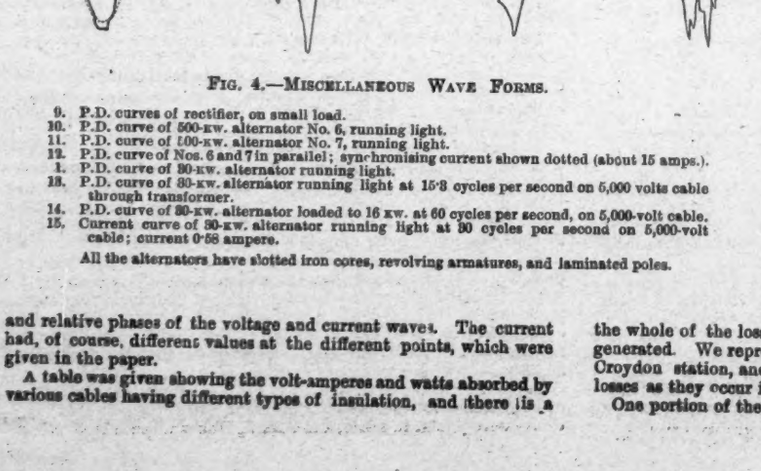

Fig. 4.—Miscellaneous Wave Forms.

9. P.D. curves of rectifier, on small load.
10. P.D. curve of 500-kw. alternator No. 6, running light.
11. P.D. curve of 100-kw. alternator No. 7, running light.
12. P.D. curve of Nos. 6 and 7 in parallel; synchronising current shown dotted (about 15 amps.).
1. P.D. curve of 30-kw. alternator running light.
13. P.D. curve of 30-kw. alternator running light at 15·3 cycles per second on 5,000 volts cable through transformer.
14. P.D. curve of 30-kw. alternator loaded to 16 kw. at 60 cycles per second, on 5,000-volt cable.
15. Current curve of 30-kw. alternator running light at 30 cycles per second on 5,000-volt cable; current 0·58 ampere.

All the alternators have slotted iron cores, revolving armatures, and laminated poles.

and relative phases of the voltage and current waves. The current had, of course, different values at the different points, which were given in the paper.

A table was given showing the volt-amperes and watts absorbed by various cables having different types of insulation, and there is a

Some are switched out during light load Notwithstanding this, the annual loss is 173,200 units, or 9·4 per cent. of the units sent out from this station. This loss would be increased by 40,000 units if some were not switched off as mentioned above.

Variation of Wave Form.—Sheets of curves are given in the paper showing the variation of wave form of the alternators due to the varying nature of the load. Some of these oscillograms are reproduced in figs. 4 and 5. In the daytime, when the load is chiefly cables, the current *leads;* as the load increases the current and voltage curves come more into phase; and at night, when the load is principally arc lighting, the current lags.

Meter Losses.—About 1,200 meters are in use, and the same number of Wright's demand indicators. Of the meters, 1,000 are Thomson and the rest of the Westinghouse type. As the shunts are always on, the loss from this source is considerable, and amounts to 51,500 units per annum. The series coil losses are small, as the current is on for but a short period each day, and a meter very rarely runs at its full rated load. The total amperage of the meters is about 3·6 times the maximum current used for private lighting.

A table given in the paper summarises the whole of the losses, which amount to 23 per cent. of the units generated. We reproduce above (fig. 1) the load diagrams of the Croydon station, and a diagram (fig. 2) showing graphically the losses as they occur in the system.

One portion of the system has been changed over from alternating

to continuous current distribution using the old L.T. mains. This resulted in a reduction of the total losses from 49,100 to 40,300 units per annum.

Discussion.

The discussion which followed was introduced by Mr. Leonard Andrews, who had investigated the losses which occurred in the various sections of plant installed at Hastings, and found that these amounted to 50 per cent. of the total units generated. He, however, introduced improvements which resulted in their reduction to 27 per cent. Comparisons were instituted between the percentage losses of the various sections of plant at Croydon and Hastings. Referring to the risks incurred in switching transformers on or off, he considered them equally as great as with cables. At Croydon it appeared that when a load of arc lamps was on, a lagging current resulted, which was contrary to his experience at Hastings. In the latter place they were substituting watt-hour meters for ampere-hour meters, and found a considerable saving of energy.

Major Cardew, looking back to the time when they framed the cable regulations, considered it lucky that they had required cables to be tested to twice their working pressure, in view of the disclosures of the oscillograms. He was discussing the sparking effect in high-tension switches when the meeting was adjourned.

REVIEW.

Secondary Batteries: Their Theory, Construction and Use. By E. J. Wade. London: *Electrician* Printing and Publishing Co.

This book, which forms one of the *Electrician* series of technical works, is a thorough attempt to bring before the reader in a concise and clear manner the whole subject of the theory, manufacture and use of secondary batteries. Indeed, it appears to be the first book published in England which deals in anything like a comprehensive manner with secondary batteries from both a commercial and theoretical aspect. It is for the most part well arranged, and edited with care, and from the clearness of its description, and the thoroughness of its detail, evidently represents a large amount of time and thought. Considering these facts, it is scarcely necessary to add that a perusal of it will undoubtedly give to practical men a very fair idea of the problems connected with the nature and use of storage batteries.

The book is devoted chiefly to the lead lead-peroxide cells (although it does not altogether neglect the other types) for, as the preface tells us, "all others still seem to be practically negligible."

The first chapter deals with the early history of secondary cells, showing their relationship to primary cells, and is introductory. Chapter II. gives a large amount of information concerning the various types of grids, supports, active material, &c., used and proposed since 1881, and the endeavour which has been made to put on record all proposals that appear to the author to be useful out of the very large number which have been tried since 1881, either in a small way or commercially, renders the chapter very interesting. For, as the author points out, many ideas now almost forgotten are as good as, or perhaps better than some, which have survived in practice to the present day, and many methods of construction have been revived, in some cases more than once, as latest improvements, after having been abandoned for many years. This chapter is also very interesting from a historical point of view, as it recalls many a half-forgotten type, and brings prominently before us the names of those who did such important work in the early years, and one is pleased to notice here that the name of Mr. J. S. Sellon receives due recognition. When the specifications of patents relating to secondary batteries are carefully perused, one can fully endorse the opinion of the author, given on page 30, in which he states that "there are not many possible directions for improvement so far as mechanical construction of pasted electrodes is concerned which Mr. J. S. Sellon does not appear to have investigated with more or less success." The descriptions are so numerous, that it is impossible to attempt discrimination, but in the pages which comprise this chapter, an excellent idea is given of the evolution of those cells most in favour at the present date.

Chapter III. is devoted to storage cells other than lead, and here we are given descriptions of all the more important proposals, beginning with the Thomson-Houston cell in 1879; the various forms of zinc lead-peroxide cells and zinc copper-oxide cells are described, finally ending with Edison's latest alkaline cells. It appears, however, somewhat to be regretted that no reference has been made in this chapter to the Jungner patents, as these will certainly prove of special interest in the event of the Edison cell ever becoming a commercial article, for if the Jungner patents do not actually anticipate Edison's they certainly appear to be to some extent on the same lines.

Chapter IV. is one which will repay most careful reading, dealing as it does with the properties and behaviour of lead cells. The fact that the chapter is largely a *résumé* of previous papers on the subject does not decrease its importance, and many—one might almost say all—the curves are of great interest, and practical men are likely to learn a good deal by their careful study. In this chapter several pages are devoted to the effect of temperature on output, a question which has received some amount of experimental attention of late years. In this connection it would have been advisable to call attention to the fact that no makers recommend that their cells should be worked at a high temperature, although it is certainly a fact that precautions are mostly insisted on to prevent a very low temperature being reached in the battery room; this is owing to the fact that a high temperature has a tendency to disintegrate the positive active material.

Chapter V. deals with the chemistry of lead cells. The first portion is largely historical. The double sulphate theory of Gladstone and Tribe and the theories of Darrieus and Fitzgerald are discussed. The various views of other experimentalists are mentioned, in some cases in detail. Dealing with the double sulphate theory, the author is still at variance with the old explanation that white lead sulphate is formed in admixture with the unaltered lead or lead peroxide, and in the section "Mixture *versus* Combination" (p. 216), and in the later section on the polymerisation theory he enters into an elaborate argument in favour of combination, adhering pretty closely to the views mentioned in his paper before the Institution of Electrical Engineers in 1900 ("Storage Battery Problems"). He is persuaded that these views are in the main correct, and that the mixture theory is untenable.

It will be remembered that, in 1900, Mr. Wade was in favour of the critical point in discharge being at one-half sulphation, viz., $Pb_3O_3SO_4$ and Pb_3SO_4. This is now modified to two-thirds sulphation, viz., $Pb_3O_2(SO_4)_2$ and $Pb_3(SO_4)_2$.

This alteration will make little or no difference to the acceptability of the theory on present knowledge. In practice the author puts the figure at a mean between two-thirds sulphation close to the support and a considerably less than one-half sulphation at points most distant from it. The polymerisation theory would gain a considerable number of adherents if good evidence were adduced that the active material exists in allotropic form, and that white lead sulphate is really irreducible under the conditions encountered in a cell. At present the weight of evidence is against both these assumptions.

The next part of the chapter refers to the thermo-chemistry of the cell, and the author evidently feels this is an important point, for, in the preface, he calls attention "to the quite unjustly discredited thermo-chemical point of view." An E.M.F. value of 1·966 volts is obtained for a cell working in a 22·3 per cent. sulphuric acid solution, as against the observed value of Gladstone and Hibbert of 2·0 volts. This is calculated from the old-fashioned double sulphation equation, due allowance being made for the presence of water. It is claimed that it may be equally true in view of the polymerisation theory, for we read on page 246, "it does not at all follow that their existence"—referring to the polymeric condition of the active materials and the special sulphate compounds—"need produce any material difference in the various heats of formation."

On pages 247-8 we are told that nothing approaching to an agreement between calculated and observed E.M.Fs. can be established on any hypothesis other than that of double sulphation, and small space is given to the thermo-chemical deductions of Darrieus and Fitzgerald (page 248).

The author has but scant sympathy with the contention of Darrieus that he finds a high voltage difference between

spongy and ordinary lead, but one notices that on page 210 Darrieus is cited as a believer in the allotropic conditions of spongy lead (which is so necessary to the polymerisation theory). Without necessarily being a disciple of Darrieus, one feels that his work and findings as (*a*) to the power of spongy lead to generate a much higher E.M.F. than ordinary lead, and (*b*) to its allotropic nature, should stand or fall together, in substance if not in degree.

Chapter VI. is devoted to the design of lead cells. The author here asks for indulgence on grounds which readily appeal to those who have experience with the matter. The chapter is, however, well written, and considering the details at the disposal of the author, the various points are put with much clearness, but no chapter or book can carry a student very far unless he has considerable theoretical and practical experience, including a practical knowledge of previous successes and failures.

Chapter VII. deals with manufacture, and a good deal of interesting matter is given in a comparatively small space. It deals with such questions as raw materials, casting, pasting, forming, acid, &c.

Chapter VIII. is occupied with treatment and testing. This chapter is, with the exception of the part mentioned below, a good one, and should be carefully studied by all those responsible for the upkeep of batteries. There is nothing much new in it, but it gives clearly and concisely the points which are so necessary to remember and act upon if batteries are to be successfully employed in commercial undertakings. It is, however, scarcely advisable to charge indiscriminately, as the disintegration of the positive active material is liable to follow. The part in this chapter which relates to the chemical testing of the electrolyte for impurities would have been better omitted. It does not appear to fairly come within the scope of the book; the suggestions are certainly not those which would commend themselves to the chemist if he were attacking the problem, and in the hands of inexperienced readers they might prove absolutely harmful.

Chapter IX., dealing with erection, connecting up, and regulation, requires no special comment, except that the author is too sanguine as to his method of preventing corrosion of brass studs and nuts by insulating from the lead lugs themselves.

The final chapter—Chapter X.—relates to present day cells. Many types are represented, and the chapter is as up to date as it can well be, but one must not forget, in reading this chapter, that we are told in the preface, the particulars of all these cells have been compiled either "from information directly furnished by the makers, or from published statements." Bearing this in mind, one will readily realise that many of the results claimed differ largely from those obtained from cells in commercial use.

The illustrations throughout the book are excellent, and the curves and tables mostly well selected. The index is divided into two parts, one a general index, and the other relating exclusively to the names of cells and electrodes. The general index might with advantage have been made somewhat fuller. The book can be confidently recommended to those who are anxious to improve their knowledge in both the theoretical and commercial side of storage batteries. It is, as we have said, carefully arranged, and the whole of the matter is very clearly put. Mr. Wade is not dogmatic, and very fairly states and weighs the arguments for and against the various theories which he describes.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Bachelor" writes:—"A firm in a line of business somewhat similar to ours have written to say that our business name resembles theirs so closely that it is likely to lead to considerable inconvenience. They inquire what steps we are prepared to take to obviate this, and say that a misunderstanding has already arisen in consequence.

"We would feel greatly obliged if you could advise us as to the reply we ought to send them under the circumstances. Are the names so closely resembling each other that they could get an injunction against us, to prevent us using ours? If they brought the case to Court and we did not defend it, should we be liable for the costs of the action? We would point out that the design of our letter, &c., sheet headings are as different as possible."

*** This is one of the class of cases with regard to which it is very difficult to express an opinion without a very full statement of facts. It is clear that if one trader adopts the name of another without any variation, the Court will grant relief; but the question whether relief will be granted, when the names differ slightly from each other, depends upon all the circumstances of the case. Thus, the fact that the two firms are dealing in, or manufacturing the same articles, and are carrying on business in the same town or district, affords strong evidence of an intention to endeavour to deceive the public; while the fact that there is a substantial difference between the titles, and that the advertisements, billheads, &c., were made as distinct as possible, may induce the Court to find that the case is not made out. The following illustrations will serve to show the nature of the case which must be made out before the Court will interfere: In the case of the Manchester Brewery Co., Ltd., *v.* The North Cheshire and Manchester Brewery Co., Ltd. (1899, 15 T.L.R., 110), it was proved that the plaintiff company, which was incorporated in 1888, did a large business in Manchester and its neighbourhood. In 1897, the defendant company was incorporated to acquire the business of the North Cheshire Brewery Co., Ltd., and in 1897, it registered its title adding the words "and Manchester."

In these circumstances the plaintiffs applied to the Court for an injunction to restrain the use of the words "*and Manchester*" as part of the defendants' title, on the ground that it was likely to lead to confusion, or to induce the belief that they had amalgamated. No allegation of fraud was made. When the case came before the House of Lords an injunction was granted, Lord Watson saying:—"The action of the appellant company was in my judgment—although I entirely free them from any imputation of fraudulent intent—one which was to the possible detriment of their neighbour, and was unjustifiable in law." On the other hand, in another recent case, it was decided that a company having the title of "Aerators, Ltd.," was not entitled to restrain another company from adopting the title of "Automatic Aerator Patents, Ltd." As the Court has regard to all the circumstances of each case, it is important to notice that the title adopted by "Bachelor's" rivals contains one word which clearly represents that they specialise in one particular branch of the industry. Moreover, theirs is a company registered under the Companies' Acts, while he makes use of the word "company," as part of his title, without the addition of the word "Limited."

Much would depend upon the date when "Bachelor" set up in business under the present firm's name; but, even assuming that he has done so since the registration of the rival company, it is extremely doubtful whether they can obtain an injunction, in view of the facts stated in the query.

As to the subsidiary question, it is clear that if "Bachelor" were to let a judgment go against him by default he would have to pay the costs. In the circumstances, he would be well advised to consult a solicitor.

"Old Subscriber" writes: "Could you please oblige by informing me in your legal queries on the undermentioned three questions:—

"'A' possesses an electric generating station, 500 volts, outside the borough boundary. 'B' possesses works inside the boundary, and wishes to take a supply for lights from 'A.' The Town Council possesses light and power orders to the boundary. From 'A's' power house to 'B's' works (300 yards), there is a road which is practically public, but is really leased to 'A,' and kept in repair by 'A,' who could close it if so willed. The land between 'A' and 'B's' works is leased partly to 'C,' who would not object to the cables going over the land. The questions are:—

"1. Can 'A' supply 'B' at 500 volts on a two-wire system, or must a three-wire system be used (B. of T. 250 volts between two terminals)?

"2. Can 'A' take the cables overhead along the roadside below 30 ft. high, and without strainers?

"Can 'A' take cables to 'B' overland with consent of 'C' at 20 ft. high without strainers?"

*** Before answering the specific questions put by "Old Subscriber," it should be observed that there is nothing in the Electric Lighting Acts which gives any local authority, or any company, which may have obtained statutory powers to supply electricity in a district, a monopoly of the supply in that district. In other words, it is always competent for any private person to supply electricity to his neighbours upon terms which may be arranged between them. Sec. 4 of the Electric Lighting Act of 1888, however, provides that where a supply of this kind involves interference with the soil of any street, or the suspension of wires over any street, or in any other manner so as not to be enclosed in any building, the Board of Trade may have power to make rules and bye-laws for the safety of the public. Further, it is within the power of any local authority by adopting Part II. of the Public Health Acts (Amendment) Act, 1890, to acquire power to make bye-laws for the prevention of danger or obstruction to the public from wires, &c. "Old Subscriber" does not say whether this Act has been adopted by the local authority in his district, but so long as he conforms to the Board of Trade Rules he has little to fear.

With reference to (1) this seems to be answered by Clause (2) of the rules prescribed by the Board of Trade under Sec. 4 of the Act of 1888. It is there laid down that the pressure shall not exceed 250 volts at any pair of terminals, except with the express approval

of the Board. Such approval is only given for special purposes, and on the joint application of the consumer and the owner, and the supply is subject to such further regulations as the Board may from time to time prescribe. In these circumstances, an application should be made to the Board of Trade.

As to questions (2) and (3), Rule (22) provides that an aerial line shall not in any part thereof be at a less height from the ground than 18 ft., or where it crosses a street 30 ft., or within 5 ft. measured horizontally, or 7 ft. measured vertically, from any building or erection other than a support for the line, except where brought into a building for the purpose of supply. Rule (26) provides that every high pressure aerial line shall be efficiently suspended by means of insulating ligaments to suspending wires, so that the weight of the line does not produce any sensible stress in the direction of its length. All suspending wires, if of iron or steel, must be galvanised. It is to be observed that these rules apply to all overhead wires. The consent of "C" is, therefore, immaterial.

"Old Subscriber" would be well advised to submit a plan of his proposed lines, &c., to the Board of Trade before erecting them.

THE SIEMENS-SCHUCKERT AMALGAMATION.

The shareholders of the Siemens & Halske Co. and the Schuckert Co. have unanimously approved the scheme for the transfer of a large portion of their respective undertakings to a new company, which will probably bear the title of the Siemens-Schuckert Works Co. It is noteworthy that, except on the part of the board, not a single voice was raised at the S. & H. meeting, either in favour of or in opposition to the amalgamation, whilst the only observations made at the assembly of the Nuremberg company emanated from two shareholders, who considered that the terms were not favourable to the proprietors. The objections of these gentlemen were, however, overcome on its being mentioned that the company had not earned any profits, and would be unable to propose any dividend for the past year. Before referring to the agreement, the report should be mentioned that, if the Siemens & Halske Co. had been unable to arrive at an understanding with the Schuckert Co., it would soon have been confronted with the necessity for establishing new dynamo works at an expenditure of at least £300,000.

The agreement provides that the new company, which will be domiciled in Berlin, will have a capital of £4,500,000, of which £2,252,500 will be assigned to the S. & H. Co. and £2,247,500 to the Schuckert Co., and of the total capital the sum of £4,000,000 will be paid up in full. The company will take over the manufacturing and sales departments of both firms in the heavy electrical engineering branches, together with the technical offices abroad, but the foreign houses of each will remain outside the combination, although a friendly co-operation in the future is in prospect.

The Siemens & Halske Co. brings in the combination the Charlottenburg dynamo works, the West-end cable works at Berlin and the brass foundry, sites and buildings, machinery and tools, manufactured and semi-finished goods and raw materials, and the stocks of the lighting and power department and electric tramway branch, and the incidental patents, trade-marks and licences. On its part, the Schuckert Co. transfers to the new company the works, buildings, machinery and tools at Nuremberg, together with stocks, patents, &c. The businesses will be taken over at the book value on April 1st, 1903, and the combination will also receive the outstanding assets, which are guaranteed by the two firms, but the latter will be individually responsible for their own liabilities. In future the S. & H. Co. will continue its other branches as hitherto, as for instance those dealing with light current work and block and railway safety appliances, and the works for the manufacture of glow lamps and arc-lamp carbons. Each of the original firms will remain in independent possession of its enterprise and guarantee businesses, and of its securities and syndicate shares, and thus the combination will only comprise manufacturing operations and sales, leaving speculative transactions entirely out of its sphere of activity.

Turning to the question of the distribution of the future profits of the combination, we note that the first six years are to be considered as a transition period, at the end of which the profits will be divided according to a complicated scheme in the proportion of about 55 per cent. for the Siemens & Halske Co., and 45 per cent. for the Schuckert Co. This scheme is based upon a system of distributing the net profits partly on the works capital, which is represented by the value of sites, buildings, machinery, tools and plant, and partly on the working capital, which is composed of the value of the materials, manufactured and semi-finished goods, claims and cash payments. It will, however, be unnecessary to enter into the details of the scheme. During the transition period the S. & H. Co. will receive preferential treatment, inasmuch as it will be paid out of profits until August 1st, 1905, at the rate of £125,000 per annum by the new company after the latter has written off £100,000 per annum for depreciation and paid £50,000 yearly to each of the original companies towards the cost of the interest on their respective bond issues. In the second period of three years from August 1st, 1905, to August 1st, 1908, the same amount will be provided for depreciation, but the preference will no longer apply. In lieu thereof the S. & H. Co. will receive out of the profits allocated to the working capital division 56 per cent., 54 per cent. and 52 per cent. respectively in the three years, whilst the share of the Schuckert Co. from this particular division will be 44 per cent., 46 per cent. and 48 per cent. On the termination of the transition period the total net profits will be distributed, as already mentioned, in such a manner that the participation of the S. & H. Co. will be represented by about 55 per cent. and that of the Schuckert Co. by 45 per cent. The board of supervision of the new company will be formed of an unequal number of persons. The S. & H. Co. will appoint the chairman, and the Schuckert Co. the vice-chairman, whilst of the other members of the board the first-mentioned company is authorised to nominate one more member than the latter company.

It will be seen from the foregoing that the shareholders have been able to sanction the transfer of their undertakings to the combination without any reference to the holders of bonds, or obligations as they are termed. In the case of the S. & H. Co., the nominal value of the bonds in existence amounts to over £1,470,000, and those of the Schuckert Co. exceed £1,590,000. These bonds were issued, as were those of other electrical companies and of many industrial companies in Germany, without having any special mortgage rights, and it has therefore not been considered necessary to consult the interests of the holders of the bonds in connection with the amalgamation.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

4,781. "Improvements in or relating to bobbins or formers, brush-holders, and the like used for electrical purposes." W. Appleyard. March 2nd.

4,783. "Improvements in connection with electrolytic cells." W. Thomson. March 2nd.

4,800. "Improvements in and relating to current generators for electric ignition purposes." A. A. Beadle. March 2nd.

4,836. "Improvements in commutators for continuous current machines." Siemens Bros. & Co., Ltd. (Siemens and Halske Actien-Gesellschaft, Germany.) March 2nd. (Complete.)

4,842. "An improved mode of collecting electric currents, and apparatus therefor." H. H. Lake. (La Société Anonyme Le Carbone, France.) March 2nd.

4,851. "Improvements relating to systems for distributing electrical energy." L. Andrews. March 2nd.

4,928. "Improvements in and connected with line selectors or switches for telephonic intercommunication." H. Oppenheimer. (Actien-gesellschaft Mix and Genest, Germany.) March 3rd.

4,930. "Improvements in or relating to electric tramcars." B. Ramsden. March 3rd.

4,944. "Improvements in and connected with single or multiple canals or conduits suitable for underground conduits for cables and for other purposes." O. Wilhelmi. March 3rd. (Complete.)

4,959. "Improvements in the electrolytic refining of copper." The Metals Corporation, Ltd., and S. Cowper-Coles. March 3rd.

4,964. "Improvements in electric hoists." H. T. Bootheroyd. March 3rd.

4,969. "Improvements in electric arc lamps." T. E. Adams. March 3rd. (Complete.)

4,972. "Improvements in telegraphic apparatus." C. Meray-Horvath. March 3rd.

4,978. "A collapsible electric light fitting or bracket." J. F. H. Collet and A. Somervell. March 3rd.

4,997. "Improvements in or connected with electric lamps." H. Smithson and E. R. Sharpe. March 4th.

5,030. "Electrically-driven circular saw bench, for cutting wood and the like." J. Bare (of the firm of J. McDowall & Sons), and R. Anderson. March 4th. (Complete.)

5,046. "Improvements in or relating to electric arc lamps." C. Oliver March 4th.

5,049. "Improvements in electric arc lamps." Crompton & Co., Ltd., A. J. Hodgson, J. W. Ewart and C. F. Tubbs. March 4th.

5,063. "Improvements in kumascopes or detectors of electric waves." J. A. Fleming. March 4th.

5,073. "Improvements in or relating to dynamo-electric or electro-dynamic machines." H. Chitty. March 4th.

5,081. "Improvements in galvanic batteries." J. Gabler. March 4th. (Complete.)

5,092. "Improved indicating or recording devices for use in connection with electricity meters, gas meters and the like." The Electric and Ordnance Accessories Co., Ltd., and L. J. Aron. March 5th.

5,097. "Improvements in and relating to overhead equipment for electric traction." M. Clayton, F. S. Clayton and T. Clayton. March 5th.

5,098. "Improvements in and relating to overhead equipment for electric traction." M. Clayton, F. S. Clayton and T. Clayton. March 5th.

5,125. "Improvements in electric stop motions for drawing frames." J. Nelson. March 5th.

5,150. "Improvements in or relating to contact-breakers for induction or sparking coils and the like." S. F. Edge and R. W. Sanders. March 5th.

5,169. "Improvements in electric rheostats." E. A. Carolan. (The General Electric Co., United States.) March 5th.

5,170. "Improvements in electric motor-control systems." E. A. Carolan. (The General Electric Co., United States.) March 5th.

5,183. "Improvements in electric transmitters for uses in telegraphy." M. Kottra. March 5th. (Complete.)

5,191. "Improvements in electrolytic breaks or interrupters for electric currents." G. Mole. March 5th.

5,204. "Improvements in and relating to brakes, particularly applicable to brakes for electric tramcars." T. Vickers and E. Andrews. March 5th.

5,224. "Electrically-driven vertical saw frames for cutting wood." J. Bare (of the firm of J. McDowall & Sons) and R. Anderson. March 6th. (Complete.)

5,236. "Improvements in means for effecting a partial or desired rotation of swivelling or rotatable trolley wheel supports forming part of the equipment of overhead traction tramcars." W. Evans. March 6th.

5,237. "Improvements in appliances for controlling electric lighting for optical, surgical and night light purposes." E. Liddle. March 6th.

5,240. "Demi-circle tube conduit system and its varieties." R. H. W. Knight and L. Nagel. March 6th.

5,247. "Improved electrical contact screw." T. B. Reader. March 6th.

5,270. "Improvements in and connected with electrical apparatus for governing and regulating the motion of motors for lifts and other purposes." G. Rosenbusch and Watgood & Otis, Ltd. March 6th.

5,278. "A new and useful folding hood for telephones." W. Mirow and A. Hepke. March 6th.

5,287. "Improvements in controlling electric motors." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,288. "Improvements in instruments for determining the power factor of alternating current electric circuits." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,289. "Improvements in rotary fans." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,290. "Improvements in systems of electrical distribution." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,291. "Improvements in dynamo-electric machines." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,292. "Improvements in electric train-control systems." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,293. "Improvements in remote electric switch control systems." E. A. Carolan. (The General Electric Co., United States.) March 6th.

5,314. "Improvements in field magnets for dynamo-electric machines or electric motors." R. Lundell. March 6th. (Complete.)

5,326. "Improvements in electric switches." P. E. Singer. March 7th.

5,337. "Improvements in series-parallel or multi-voltage controllers for electric motors." A. E. Gott, A. Holmes, J. H. Holmes, W. Holmes and E. Holmes. March 7th.

5,338. "Improvements in spark gap connections." P. L. Renouf. March 7th.

5,393. "Improvements in connection boxes for electric cables." E. Parry W. Bidder and E. J. Scows. March 7th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 323, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

252. "An improved switch for electric currents." J. W. Hintze. Dated January 4th.

993. "Improvements in or relating to telegraph and telephone wires." J. Womersley and G. W. Womersley. Dated January 14th.

1,402. "Improved means for operating the points of the overhead wires and of the rails on electric tramways." H. Collins and C. W. Collins. Dated January 18th.

1,435. "Improved coupling joint or connection for electric wires and fittings." M. Railing and G. H. Ide. Dated January 18th.

1,684. "A method for producing electrodes." E. W. Jugner. Dated Jan. 21.

2,248. "Improvements in electric galvanic belts." H. H. Lake. (S. J. Spalding, United States.) Dated January 28th.

2,825. "Improvements in time electric switches." H. J. Cogswell. Dated February 4th.

3,374. "An improved protective operating device for electric motors and like purposes." J. Y. Johnson. Dated February 10th.

3,416. "Improvements in switches for electric light circuits and the like." J. Jones. Dated February 11th.

3,490. "Improvements in lightning dischargers for electrical installations." Siemens Bros. & Co., Ltd. Dated February 11th.

3,491. "Improved brush-holder for electrical apparatus." Siemens Bros. and Co., Ltd. Dated February 11th.

3,592. "Improvements in winding and circuit closing devices for electrically-wound clocks." C. M. Crook. Dated February 11th.

3,610. "Improvements in electrically propelled vehicles for single rail elevators." F. B. Behr. Dated February 12th.

3,667. "Improvements relating to insulated electrical conductors." J. F. Cummings. Dated February 12th.

3,811. "Improvements in electrical signalling apparatus for railways." W. J. Mildon. Dated February 14th.

3,894. "Improvements connected with the use of electric glow lamps for occasional illuminations." F. Brown. Dated February 15th.

3,953. "Improvements relating to telegraphic and telephonic apparatus." H. H. Lake. Dated February 15th.

4,006. "Improvements in or relating to dynamo-electric machines." A. J. Boult. (T. B. Hatch.) Dated February 18th.

4,273. "Improvements relating to automatic electric fire alarms." P. Offenbroich and L. Mafell. Dated February 19th.

4,372. "Improvements in and relating to electrical warp and weft controlling mechanism for looms." F. E. Kip. Dated February 20th.

4,374. "Improvements in and relating to electric arc lamps." J. A. Rignon and E. Eisenmann. Dated February 20th.

4,377. "Improvements in electrically printing a inkless typewriters." J. C. Fell. Dated February 20th.

4,445. "An improved automatic telephone system." E. A. Faller. Dated February 21st.

4,520. "Improvements in or relating to electric batteries." V. G. Apple. Dated February 22nd.

4,521. "Improvements in or relating to storage batteries." V. G. Apple. Dated February 22nd.

4,522. "Improvements in or relating to electric ignition apparatus for internal combustion engines." U. G. Apple. Dated February 22nd.

4,608. "An improved receptacle for watches in connection with a source of electric light." C. Arnold. Dated February 24th.

4,650. "Improvements in signalling systems for electric railroads." O. W. Hart. Dated February 24th.

4,729. "Improvements in and relating to electric incandescence lamp-holders." C. D. Knowles. Dated February 25th.

4,754. "Improvements in field magnets for dynamo-electric machines or electric motors." R. Lundell. Dated February 25th.

4,755. "Improvements in incandescent electric lamps." E. McOnat. Dated February 25th.

4,865. "Improvements in automatic circuit breakers of induction apparatus." V. Barreto. Dated February 26th.

4,906. "Improvements in or relating to dynamo-electric machines." A. J. Boult. (T. B. Hatch, U.S.) Dated February 26th.

4,936. "Improvements in or connected with conduits or pipes for electric cables and the like." W. Oates. Dated February 27th.

5,065. "Improvements in overhead electric trolley wires." J. P. Cribb. Dated February 28th.

5,103. "An improved means of and apparatus for connecting the conductors or armour of electric cables and the like to junction boxes, earth plates and other parts." The Callender Cable and Construction Co., Ltd., and J. C. A. Ward. Dated February 28th.

5,104. "Improvements in arc lamps and electrodes therefor." La Société G. et P. de Mistral. Dated February 28th.

5,122. "Improvements in electric switches." W. Loemen. Dated February 28th.

5,366. "Improvements relating to electric accumulators." J. E. G. Méran. Dated March 4th.

5,468. "Improvements in trolley heads for electric tramcars." W. Willenbücher. Dated March 5th.

5,530. "Improvements in apparatus for measuring and indicating an electricity supply." C. H. Merz. Dated March 5th.

5,592. "An electric self-registering target." W. G. Williams and H. H. Edwards. Dated March 6th.

5,618. "Improvements in or connected with wireless telegraphy." J. Cervera. Dated March 6th.

5,618. "Improvements in and connected with interrupters for induction coils." J. Cervera. Dated March 6th.

5,663. "Improvements in electrical fuse boxes." L. M. Waterhouse and others. Dated March 7th.

5,711. "Improvements in devices for driving dynamos." J. F. Jacob. Dated May 7th.

5,802. "An improved electric safety fuse appliance." Siemens Bros. & Co., Ltd. Dated March 8th.

5,818. "An improved arrangement for the prevention of pulsations and sudden alterations in periodicity in alternating current generating plants." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft.) Dated March 8th.

5,862. "Improvements in rehostats." J. Lundie. Dated March 10th.

5,944. "Improved telegraph systems." W. L. Wise. (J. H. Pierce.) Dated March 11th.

5,977. "Improvements in apparatus for operating railway signals, switches, and the like." H. H. Lake. (Standard Signal Co., United States.) Dated March 11th.

5,982. "Improvements in electric telegraph systems and relating more particularly to wireless systems." H. Shoemaker. Dated March 11th.

6,184. "Improvements in section insulators for electric trolley conductors." H. Hirst and W. Wood. Dated March 13th.

6,209. "Improvements in or relating to electric arc lamps." S. H. Johnson. Dated March 13th.

6,229. "Improvements in electric typewriters." K. H. Kochendörfer. Dated March 13th.

6,331. "Improved electrical cooking apparatus." M. Masterton and P. Southard.

6,346. "Improvements in and relating to electro-magnetic circuit breakers or cut-outs." E. L. Joseph and Gardiner.

6,379. "A continuous burning arc lamp with inclined carbons." J. A. Rignon and E. Eisenmann. Dated March 15th.

6,478. "Improvements relating to storage batteries." H. C. Porter. Dated March 17th.

6,481. "Improvements in wireless telegraph systems." H. Shoemaker. Dated March 17th.

6,854. "An improved system of electrical distribution." P. A. Newton. Dated March 20th.

6,855. "Improvements in brush mechanism for dynamos." P. A. Newton. Dated March 20th.

7,062. "Improvements in or relating to overhead trolleys for electric vehicles." F. Häller and R. Noiset. Dated March 22nd.

7,169. "Electric battery." C. A. Allison. (W. C. Banks, U.S.A.) Dated March 24th.

7,188. "Improvements in means for the control of electrically-driven reversible rolling mills." C. Ilgner. Dated March 24th.

7,361. "Improved means of connecting continuous current motors to the supply network on starting." Siemens Bros. & Co., Ltd. Dated March 26th.

7,383. "Improvements in electric arc lamps." P. Högner. Dated March 26th.

7,447. "Improvements in the electric transmission of power." Otis Elevator Co., Ltd. Dated March 27th.

7,661. "Improvements in and relating to the electrolytic refining and deposition of lead." A. G. Betts. Dated April 1st.

7,689. "Improvements in electric signalling on railways." J. B. Struble. Dated April 1st.

7,851. "Improvements relating to electrical sterilising and preserving apparatus." H. H. Lake. (L. D. Giroux and L. E. Seddon, U.S.) Dated April 3rd.

7,858. "Improvements in and relating to electric vacuum discharging tubes." M. Krouchkoll. Dated April 3rd.

7,935. "Improvements in the production of metallic deposits by electrolysis." P. Jensen. (Dr. G. Langbein & Co., Germany.) Dated April 5th.

8,486. "Improved means for operating the carriages and controlling mechanism of the same, of electric, telegraphic, and similar machines." P. M. Justice. (The Rowland Telegraphic Co.) Dated April 11th.

8,488. "Improved method of and means for producing synchronous motion." P. M. Justice. (The Rowland Telegraphic Co.) Dated April 11th.

8,487. "Improvements in transmitting devices for electric, telegraphic and like apparatus." P. M. Justice. (The Rowland Telegraphic Co.) Dated April 11th.

8,643. "Improvements in or connected with means for damping the oscillations of shafts carrying the hands or pointers of electrical measuring instruments or the like." F. N. Nalder and others. Dated April 14th.

8,667. "An improvement in the method of regulating the pressure of alternating current dynamo-electric generators." Siemens Bros. & Co., Ltd. Dated April 14th.

8,670. "Improvements in electric arc lamps." T. L. Carbone. Dated April 14th.

8,717. "Improvements in or relating to luminous-gas electric lamps." W. Fairburn-Hart. (The General Electric Co.) Dated April 15th.

8,784. "Improvements relating to rail bonds or connections for electric railways." H. H. Lake. (E. G. Thomas.) Dated April 15th.

8,809. "Improvements in electric circuit controllers." J. J. Ghegan and E. J. Griswold. Dated April 15th.

8,843. "A new or improved device or apparatus for disinfecting by electric light irradiation." H. L. Wiedemeyer. Dated April 16th.

8,872. "Improvements in switches for electric lighting." S. Bach. Dated April 16th.

8,969. "Improvements in dynamo-electric generators." A. J. Haddon. (H. L. Peck.) Dated April 17th.

9,229. "Improvements in audible electric telegraphy." R. Oxlade and W. J. W. Richardson. Dated April 21st.

9,380. "Improved fuse head for electric blasting." F. Render. Dated April 23rd.

9,504. "Improvements in electric lamp sockets." M. Norden. Dated April 24th.

9,704. "Improvements in and relating to electric switches and wall plugs and bases for the same." A. Vandam and T. H. Marsh. Dated April 26th.

9,720. "Improvements relating to automatic electric fire alarms." P. Offenbroich and L. Mafell. Dated April 26th.

9,788. "Improvements in electric switches and in the application of the same to electrically-propelled vehicles." W. M. Brown. Dated April 28th.

9,789. "Improvements relating to electric railway systems and more particularly to crossings and switches for the same." H. E. Keller. Dated April 28th.